Dependency and Vulnerability: Japan's Beef and Feed Grain Imports in a Turbulent World Economy

Dusit Jesdapipat[1]

Abstract: Japan's policies and import demand structures for beef, maize, and sorghum were reviewed and quantified using a system of 12 seemingly unrelated equations consisting of 12 endogenous and 23 exogenous variables. Empirical implications drawn from this model indicated that Japan's beef import quota is one of the significant factors that determine Japan's total beef imports and countries of origin. Hence, by the large country assumption, Japan could benefit from its protectionist beef import policy. The model also confirmed that price competition existed between Australian and New Zealand beef of identical quality and that US beef substitutes for beef from Oceania, due to quotas. The *ex ante* simulations showed a trade-off between beef and feed grain imports in addition to potential cross substitution of similar commodities from different sources of supply and from such close substitutes as maize and sorghum. The USA dominated the maize and sorghum trade because its exports of those commodities to Japan dominated Japan's demand functions for the commodities from other sources. For feed grain trade, the freight rates between the US Gulf ports and Japan influenced neither Thailand-Japan maize trade nor Australia-Japan sorghum trade. Australia's exportable supply of sorghum influenced both US-Japan and Australia-Japan trade in sorghum, which in turn influenced sorghum trade between Argentina and Japan.

Introduction

Beef dominates Japan's trade disputes with its trading partners, especially the USA and Oceania. Japan's protectionist beef import policy has been criticized as being costly to its government, consumers, and overseas beef producers (Bale and Greenshields, 1978). A call for "freer" and "fairer" trade in rounds of international trade negotiations often results in the general realization that the trade issue involves more than economics (Timmer and Reich, 1983; and Nobuyuki, 1983). Japan defends its policy by citing identical trade barriers in other countries (such as the *Meat Import Law of 1964* in the USA) and by pointing out that Japan is the world's largest single importer of agricultural products. Food security is also used to portray Japan's vulnerability (Ota, 1983). Some economists, who believe that the Japanese dietary pattern is one of the government's responsibilities, suggest that "...appropriate price relationships be maintained among competing foods so that a desirable dietary pattern of the people may develop" (Konosu, 1982, p. 19). The rather low per capita beef consumption compared to other nations with comparable incomes is seen as an ideal, "well-balanced" diet pattern (APRC, 1982). Consequently, coordinating the national domestic agricultural policy and imports is one of the Japanese government's prime tasks. In today's turbulent world economy, this government role is a source of instabilities and thus has to be endogenized in trade and agricultural models (Schuh, 1981; and OECD, 1980).

This study has three parts. First, Japan's interrelated beef, maize, and sorghum imports during 1965-82 are modelled using the Resnick-Truman model, which recognizes product heterogeneity by source of supply. Second, a simulation technique is applied to test the stability of import demand and to forecast changes in imports when certain economic conditions and policy actions are given. Third, policy implications for Japan's future trade in beef, maize, and sorghum are drawn from the results.

Statistical Model and Data

The theoretical model constructed is a system of seemingly unrelated equations that can be efficiently estimated by such system estimators as Aitken's generalized least squares or the maximum likelihood method (Kmenta, 1971).

The statistical model is comprised of 3 identities and 12 endogenous and 23 exogenous variables classified into 5 sets: own- and substitute-product prices, policy variables, demand and supply factors, transport costs, and the stochastic terms. Total imports of beef, maize, and sorghum are assumed to be determined simultaneously, and the subsequent decision allocates these individual imports among suppliers (Resnick and Truman, 1973). The total supply (excluding the negligible domestic supply) is taken to be elastic within a certain range but less than infinite. Annual data for 1965-82 are used in actual estimations. Beef includes meat of bovine animals: fresh, chilled, or frozen, and bone-in or boneless. Maize and sorghum are imported for feeding purposes only. All data used were collected in Japan, the USA, and Thailand in the summer of 1983.

Empirical Results

Three identical models were acquired from empirical estimations, using the three-stage least squares estimator. Since there is no *a priori* knowledge to choose the "best" model, *ex post* and historical simulation procedures and turning point error (TPE) and root-mean-square error (RMSE) are used collectively as criteria in the selection (Kost, 1980).[2] Table 1 presents the chosen model, and the variables are defined in Table 2 (page 271). The following observations can be made from the results. The beef quotas (which are determined on the basis of beef consumption per capita in Japan), the 1 year lagged retail price of beef in the Tokyo market, and its domestic retail price variance directly influence Japan's total beef imports and beef imports from the USA and New Zealand. The quotas affect imports of Australian beef through total imports. The maize-fed beef from the USA could replace some imports from Oceania due to the import restriction. Effects of any changes in the beef import policy of Japan would be felt to different degrees among its beef suppliers, depending on Japan's import demand structures, its purchasing power, and import price elasticities.

Changes in the imports of beef apparently depend significantly on domestic supply, which relies heavily on the freely imported feed grains. The annual requirements for these feed grains, which consist mainly of maize and sorghum, can be identified by the number of livestock and poultry in Japan, the relative import prices of maize and sorghum, and prices of soybeans in central Illinois.

The price factor in the individual imports of maize and sorghum does not have a clear statistical significance, perhaps because of Japan's high dependence on imports. The relatively limited number of sources of supply and the world supply of maize and sorghum have forced Japan constantly to import these grains from the USA, which has an enormous share in Japan's total imports of feed grains. However, exceptions do exist. Japan's imports of Thai maize, for example, occurred despite higher import prices of Thai than US maize. In such cases, the price factor in Japan's import demand for Thai maize has clearly been overruled by such other factors as diplomatic reasons, shipping convenience, and the bilateral trade agreement. Japan's trade in sorghum with Australia may be put in the same perspective.

Even though the hypothesis regarding the shipping advantages of Thailand and Australia to Japan, as compared to the USA, cannot be explicitly tested in this study because of the lack of relevant data, the rather crude approximation made by relating the transport costs of grains between the US Gulf ports and Japan to feed grain imports has indicated that the relationship is probably weak and statistically insignificant. This may be due to Japan's constantly rising demand for feed grains as well as the minor share of transport costs in the total value of grains. Overall, the availability or supply factors consistently influence both Japan's maize and sorghum purchases from alternative sources.

Japan's dependency and vulnerability can be tested in the subsequent *ex ante* simulations under the restricted and free trade assumptions and changes in general economic situations. The results show that the model fails to account for the magnitude of beef imports after the quota is lifted.[3] A significant trade-off occurs between beef and feed grain imports. The outcomes also indicate unequal changes of imports from individual suppliers—a confirmation of product heterogeneity. To Japan's trading partners, the empirical model and its *ex ante* simulations in this study imply that liberalizing beef trade itself may not (in and of itself) lead to as dramatic an increase in Japan's purchase of beef in the world market as the USDA (1984) has estimated, nor would it guarantee that Japan's beef and feed grain suppliers would benefit equally from liberalization. This result is due to the heterogeneity of beef and feed grains portrayed and captured in the present model formulation. The results obtained here differ from Whitacre (1979), who used a programming method that does not take into account product heterogeneity.

Conclusion

As a "large" country, Japan could theoretically benefit from its protectionist policy. However, some aspects of the reality do not rule out the feedback effects resulting from its policy that could introduce instabilities into the world market, thereby destabilizing overall economic relationships. One effect is that beef exporters may retaliate because Japan's import quotas have restrained their exports. Another is the significance of total imports of maize and sorghum in many individual feed grain demand functions, which reflects Japan's need for overseas inputs for its livestock—the need that in many cases plays down the role of price in the demand relationship. Hence, its costly

Table 1—Empirical Results, Japan's Beef, Maize, and Sorghum Imports, 1965-82

Equation	Variable	Estimate	Standard Error	*t*-Ratio	Probability †
BTQ *	Intercept	-9,015.92	8,698.64	-1.04	31.76
	-XBP	39.96	63.37	0.63	53.84
	*+QUOTA**	0.44	0.06	6.85	0.01
	+GNP	0.28	0.04	6.35	0.01
*QUOTA**	Intercept	-86,409.40	26,498.59	-3.26	0.57
	+LAGRPB	-331.34	180.70	-1.83	8.80
	?VAR	0.40	0.19	2.13	5.12
	+CON	62,437.99	14,327.03	4.36	0.07
*BUSQ**	Intercept	-10,903.00	3,722.41	-2.93	1.17
	-BXUSP	3.79	6.35	0.60	56.08
	+CGNP	14,378.75	2,767.64	5.20	0.02
	-AUNZ	0.12	0.09	1.43	17.66
	*+QUOTA**	-0.07	0.05	-1.45	16.97
*BAUQ**	Intercept	-4,244.13	1,041.44	-4.08	0.13
	*-BUSQ**	-0.75	0.04	-18.12	0.01
	-BXAUP	-7.91	7.41	1.07	30.53
	+BXNZP	26.11	7.50	3.48	0.41
	*+BTQ**	0.88	0.01	106.78	0.01
*BNZQ**	Intercept	3,642.37	1,021.32	3.57	0.34
	*-BUSQ**	-0.03	0.03	-0.87	40.08
	+BXAUP	12.15	6.47	1.88	8.32
	-BXNZP	-32.06	6.91	-4.64	0.05
	*+QUOTA**	0.05	0.01	9.48	0.01
*CTQ**	Intercept	-7,750.42	1,521.45	-5.09	0.05
	-XCP	-0.94	0.27	-3.41	0.66
	+XSP	0.92	0.30	3.11	1.11
	+CATT	3.31	0.78	4.24	0.17
	+CHIC	-0.02	0.01	-1.86	9.20
	+HG	0.55	0.18	3.03	1.28
	+SOYP	344.40	76.17	4.52	0.11
	-FR	40.72	22.15	1.84	9.59
*CUSQ**	Intercept	-1,410.68	317.37	-4.44	0.07
	*-STQ**	-0.21	0.07	-2.94	1.14
	*+CTQ**	1.22	0.03	36.07	0.01
	-CXUSP	-0.01	0.03	-0.25	80.40
	*-CTHQ**	-0.06	0.22	-0.25	80.73
*CTHQ**	Intercept	406.72	137.92	2.95	1.06
	*-CUSQ**	-0.05	0.02	-2.63	1.98
	+FR	-10.33	6.93	-1.49	15.81
	-CXTHP	0.06	0.01	4.38	0.06

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Table 1—Empirical Results, Japan's Beef, Maize, and Sorghum Imports, 1965-82, continued

Equation	Variable	Estimate	Standard Error	*t*-Ratio	Probability †
*STQ**	Intercept	5,663.07	1,922.72	2.95	1.47
	-XSP	-1.45	0.43	-3.36	0.73
	+XCP	1.33	0.40	3.35	0.73
	+CATT	-3.26	0.99	-3.28	0.82
	+CHIC	0.05	0.01	3.73	0.39
	+HG	-0.16	0.24	-0.67	51.81
	+SOYP	164.15	108.24	1.52	16.03
	-FR	-15.61	26.21	-0.60	56.47
*SUSQ**	Intercept	776.94	554.22	1.40	18.63
	-SXUSP	-0.19	0.15	-1.24	23.77
	+SXARP	0.20	0.16	1.32	21.27
	*+STQ**	0.25	0.12	2.16	5.17
	*-CTQ**	0.08	0.05	1.73	10.91
	-SAUX	-0.21	0.07	-2.87	1.42
*SAUQ**	Intercept	272.22	144.40	1.89	8.20
	+SAUX	0.39	0.08	4.71	0.04
	*-SUSQ**	-0.32	0.10	-3.24	0.65
	+FR	11.23	7.55	1.49	16.04
	-SXAUP	0.06	0.01	4.50	0.06
*SARQ**	Intercept	-1,030.73	525.84	-1.96	7.36
	+SXUSP	0.09	0.14	0.66	52.34
	-SXARP	-0.12	0.15	-0.85	41.26
	*-CTQ**	-0.08	0.04	-1.94	7.66
	*+STQ**	0.82	0.11	7.21	0.01
	*-SAUQ**	-0.57	0.09	-6.14	0.01

[Table 1 footnotes: †Probability of rejecting the null hypothesis that the estimates do not differ from zero. *Endogenous variables. Note: Definitions of the variables are provided in Table 2, and the signs preceding the variables are the expected relationships in the models.]

[Table 2 footnotes: *The coefficient a in the import demand equation $Q = aP + e$, reflects a relative change in the quantity demanded (Q) and the price (P) inclusive of the current exchange rate, with e being an error term. Therefore, a is a function of the exchange rate, EXR, the relationship of which can be approximated by $a = bEXR + c$, where b is a parameter and c is the error term. This relationship demands a respecification of the demand equation to include the exchange rate such that $Q = b(EXR)P + d$, where d is the error term. Thus, the effect of the exchange rate on imports is measured indirectly through the relative change in Q and the "compound" price, $(EXR)P$. †Because of the different magnitude of exports from individual countries, the compound prices in the total import equations were further weighted by the shares of individual countries in Japan's market.]

Table 2—Variables Used in the Empirical Models

Variable	Definition
AUNZ	*BAUQ* + *BNZQ* (t)
BTQ	Total beef imported into Japan (t)
BUSQ	Annual beef imports from the USA into Japan (t)
BAUQ	Annual beef imports from Australia into Japan (t)
BNZQ	Annual beef imports from New Zealand into Japan (t)
BUSP	C.i.f. price of US beef (¥1,000,000/t)
BAUP	C.i.f. price of Australian beef (¥1,000,000/t)
BNZP	C.i.f. price of New Zealand beef (¥1,000,000/t)
*BXUSP**	*EXR x BUSP*
*BXAUP**	*EXR x BAUP*
*BXWZP**	*EXR x BNZP*
CTQ	Total maize imported into Japan (Mt)
CUSQ	Annual maize imports from the USA (Mt)
CTHQ	Annual maize imports from Thailand (Mt)
CUSP	C.i.f. price of US feed maize (¥1,000/t)
CTHP	C.i.f. price of Thai feed maize (¥1,000/t)
*CXUSP**	*EXR x CUSP*
*CXTHP**	*EXR x CTHP*
CATT	Beef cattle and dairy cattle population, Japan (1,000 head)
CGNP	Per capita GNP, Japan (¥1,000/person)
CHIC	Broiler and layer population, Japan (1,000 birds)
CON	Per capita beef and veal consumption, Japan (kg/person)
EXR	Selling exchange rate, Tokyo (¥/dollar)
FR	Weighted average annual freight rate for coarse grains, Gulf ports-Japan (dollar/t)
GNP	Gross national product, Japan (¥1,000,000,000)
HG	Hog population, Japan (1,000 head)
LAGRPB	Lagged annual average retail price of beef, Tokyo market (¥/100 g)
QUOTA	Average annual beef import quota, Japan (t)
STQ	Total sorghum imported into Japan (Mt)
SUSQ	Annual sorghum imports from the USA (Mt)
SAUQ	Annual sorghum imports from Australia (Mt)
SARQ	Annual sorghum imports from Argentina (Mt)
SUSP	C.i.f. price of US sorghum ((¥1,000/t)
SAUP	C.i.f. price of Australian sorghum (¥1,000/t)
SARP	C.i.f. price of Argentine sorghum (¥1,000/t)
*SXUSP**	*EXR x SUSP*
*SXAUP**	*EXR x SAUP*
*SXARP**	*EXR x SARP*
SAUX	Annual exportable supply of feed sorghum in Australia (t)
SOYP	Average annual cash price of soyabeans, Decatur, Ill. ($/bu)
VAR	Squared deviation from the 1965-82 average of annual retail beef prices, Tokyo market (percent)
WWBP†	Weighted average (by import share) of imported price of beef from all sources, Japan (¥1,000,000/t)
WWCP†	Weighted average (by import share) of imported price of feed maize from all sources, Japan (¥1,000,000/t)
WWSP†	Weighted average (by import share) of imported price of feed sorghum from all sources, Japan (¥1,000,000/t)
*XBP**	*EXR x WWBP*
*XCP**	*EXR x WWCP*
*XSP**	*EXR x WWSP*

[Footnotes are on the previous page.]

protectionist beef import policy alone only makes Japan more vulnerable as growth in the demand for beef and feed grains continues. Japan will thus have to re-evaluate its present import policy and design a new, less costly policy that would lead to better trade relationships. While strongly emphasizing the establishment of the domestic livestock industry, the new policy should also allow imports to grow with total demand. This policy would make Japan less vulnerable to any retaliation because of the greater economic interdependence and the stronger livestock industry at home.

Notes

[1]Maejo Institute of Agricultural Technology.
[2]For further details, see Jesdapipat (1984).
[3]See Jesdapipat (1984).

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