Impacts of Liberalizing the Japanese Pork Market

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ABSTRACT

The Japanese pork market is protected by a complex set of restrictions, including a variable levy and an import tariff. The combination of these policies distorts the quantity, price, and form of Japanese pork imports. An important issue relevant to the liberalization of the Japanese pork market is the accurate measurement of the price wedge between Japanese and world pork prices. The analysis indicates that the tariff equivalent of the price wedge over the 1986-88 period was 44 percent. If the tariff equivalent of the price wedge is reduced over a ten-year period, Japanese pork imports are projected to increase by over 39 percent initially and by over 380 percent by 2000. Producer welfare can be maintained by a deficiency payment scheme. A less costly alternative is an industry buffer scheme, which maintains the level of the pork industry for two years and then implements a declining deficiency payment scheme that limits the decrease in production levels to 5 percent per year.

IMPACTS OF LIBERALIZING THE JAPANESE PORK MARKET

In the summer of 1988, under pressure from the United States, Australia, and Canada, Japan agreed to slowly open its beef market. Analysis of the agreement (Wahl, Hayes, and Williams 1991) indicates that this reduction in trade barriers and concomitant reduction in prices will result in a substantial increase in beef consumption in Japan.[1] These dramatic price changes will influence the prices and consumption levels of all meats and meat substitutes. The Japanese pork market in particular will be influenced by beef liberalization because of the high degree of substitutability between beef and pork.

The resulting relative increase in pork prices may attract attention to Japan's import restrictions by both pork-exporting countries and Japanese consumers, which leads to the possibility that Japan's pork market may also be liberalized. The purpose of this paper is to assess how liberalization, including tariffication, of Japan's pork market would influence Japanese pork production, consumption, and imports. Related issues include the accurate measurement of the price wedge between domestic and world prices and the welfare implications of liberalization.

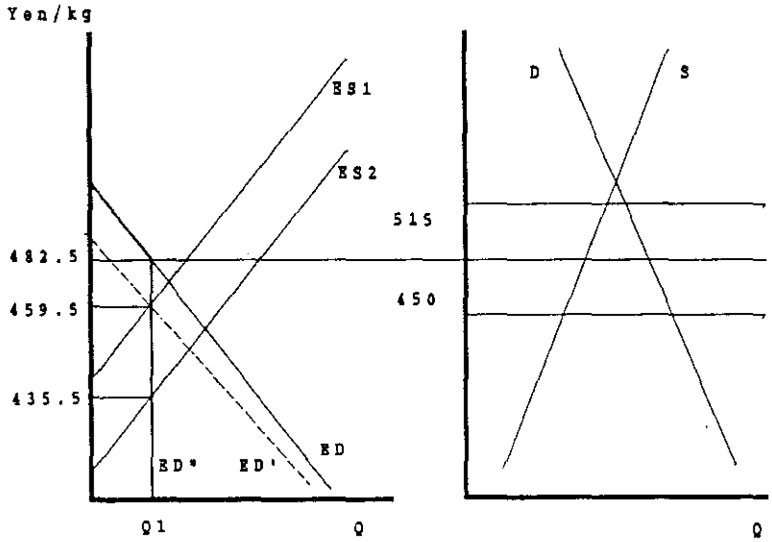
This paper reviews Japan's current pork import policies and discusses tariffication of these policies. An econometric model of Japan's pork sector is then presented. The impacts of liberalization are presented, including projections of how Japanese pork producers and consumers will respond. These results have direct implications for trade negotiators and producer welfare. The penultimate section examines alternatives to compensate producers for their welfare losses. Finally, the important policy results are summarized.

Japanese Pork Import Policies

Japan maintains high domestic pork prices by using a price-stabilization band coupled with a variable import levy and an import tariff. The upper and lower price bands are set to support producer profits at a politically acceptable level, and the arithmetic average of the two prices determines the standard import price. A variable levy equal to the difference between the actual import price and the standard import price is then calculated. In addition, a 5 percent ad valorem tariff is charged on all imports. Figure 1 presents the combined impact of these policies.

The panel on the right side of Figure 1 represents the demand and supply curves for the Japanese market. The left panel represents the excess demand curve for Japan and the excess supply curve for the rest of the world. In 1989, upper and lower bounds of the stabilization band were 515 yen/kg and 450 yen/kg, respectively, which led to a standard import price of 482.5 yen/kg. In this example, Japan will not allow pork to enter at a price lower than 482.5 yen/kg. Because Japan also charges a 5 percent ad valorem tariff on all imported pork, the gate price (459.5 yen/kg) is the price that, when increased by 5 percent, equals the standard import price (459.5 yen/kg · 1.05 = 482.5 yen/kg).

The dotted line, ED′, in Figure 1 represents the excess demand curve facing exporters after accounting for the 5 percent ad valorem tariff. The intersection of ED′ and ES1 results in a cost, insurance, and freight (CIF) price in Japan of 459.5 yen/kg, which, when the tariff is added, results in an import price of 482.5 yen/kg and an import quantity of Q1. When the variable levy is accounted for, the effective excess demand curve becomes ED″. The intersection of ED″ and ES1 results in a zero variable levy. When the excess supply curve shifts to ES2, the CIF price in Japan is determined by the intersection of ES2 and ED″ at a price of 435.5 yen/kg and the variable levy equals the difference between 459.5 yen/kg and 435.5 yen/kg. The variable levy is therefore equal to



World market Japanese market

Figure 1. Japanese pork import policies

the difference between the gate price and the marginal supply price that is determined by the intersection of the excess supply curve and the effective excess demand curve, ED″.

Pork importers have responded to these incentives by ensuring that the average unit value (the price upon which the tariff is assessed) for each container load of imported pork equals the gate price. This is accomplished by adding more or less of the more expensive cuts as world prices rise and fall. Consequently, the reported unit import price almost always equals the gate price.

Tariffication of Japan's Pork Import Policies

In mid-1989, the U.S. General Agreement on Tariffs and Trade (GATT) negotiating team proposed that food-importing countries replace all trade-distorting policies with tariffs. Once these tariffs have been agreed upon and imposed, countries would begin a phased reduction of the tariffs over an agreed-upon period. The U.S. proposal suggested using the average of the tariff equivalent over the 1986-88 period as a base from which the phased reduction would begin. The proposal received favorable comment from most members and seems the most likely outcome regarding import restrictions as of April 1991.

To analyze the impacts of Japanese acceptance of this proposal, it is first necessary to measure the tariff equivalent of Japan's import policies. A naive interpretation of Japan's import statistics might lead to the conclusion that the combined effect of its policies is equivalent to a 5 percent tariff (the difference between average import unit values and equivalent domestic prices or the difference between the gate price and the standard import price). In reality, the effect of these policies is much greater. The process of adding more expensive cuts such as loins to increase the average import value implies costs for both importers and exporters. Exporters must find additional markets for the lower quality cuts that remain after the higher quality cuts have been exported. In addition, importers must sell a greater proportion of the better quality cuts than would normally be the case, and both parties incur significant paperwork and time-consuming negotiations, particularly when the standard import price changes.

An alternative measure of the tariff implied by Japan's pork import policies is the difference between the wholesale Japanese pork price and the wholesale pork price (adjusted for transportation costs) in the countries that export to Japan. This price wedge measure has intuitive appeal because it represents the "added" cost of imported pork to Japanese importers. If the tariff equivalent calculated by using this price wedge happened not to maintain current trade flows after liberalization, arbitrage opportunities would exist and could be used as a basis for further negotiation and adjustment.

The tariff equivalent for pork imported from the United States can be calculated as

$$PORTE = (PORPC - PORPM)/PORPM,$$

$$PORPM = (USPORPC + USJATRAN) \cdot (XJAUS) \cdot 2.2, \qquad (1)$$

where *PORTE* is the tariff equivalent of trade restrictions, *PORPC* is the domestic price of pork, *PORPM* is the border price of imported pork, *USPORPC* is the U.S. price per pound of pork, *USJATRAN* is the transportation cost from the United States to Japan, *XJAUS* is the exchange rate (Japanese yen/U.S. dollar), and 2.2 is the pound-to-kilogram conversion factor.

Based on (1), the calculated tariff equivalents plus a 10 percent profit margin for U.S. pork from 1986 through 1989 are presented in Table 1. The first column of Table 1 presents the Japanese wholesale carcass price of pork. The second column presents the comparable U.S. wholesale carcass price. The approximate transportation cost for shipping pork from the United States to Japan is listed in the third column. The fifth column shows the calculated price for U.S. pork (in yen/kg), including a 10 percent profit margin at the Japanese border. The last column provides the tariff equivalent or markup necessary to equate columns 1 and 5. As shown, the tariff equivalent, which is calculated by using the Japanese wholesale pork price and the U.S. wholesale price at Japan's border, ranged from

Table 1. Calculation of the Japanese tariff equivalent for pork by using U.S. pork prices, 1986 through 1989

Year	Japanese Price (¥/kg)	U.S. Price ($/lb.)	U.S.-Japan Transportation[a] ($/lb.)	Exchange Rate ($/¥)	Border Price (¥/kg)	Tariff Equivalent (%)
1986	543.0	0.815	0.20	167.50	411.3	32.0
1987	498.0	0.819	0.20	144.22	355.9	39.9
1988	483.0	0.749	0.20	128.02	294.3	64.1
1989	515.0	0.756	0.20	137.63	318.5	61.6
1986-88 Average	508.0	0.794	0.20	146.58	352.6	44.1

Note: See Hayes (1990) for details on the data sources.

[a]Transportation costs from the United States to Japan are calculated based upon a $323/metric ton (mt) ocean shipping rate and a $120/mt shipping rate from the Midwest to the West Coast for 18-mt containers.

32 percent to 64 percent and was much greater than 5 percent. The average for 1986 through 1988 was 45 percent.

The Japanese Livestock Industry Model

The effects of gradual liberalization of Japan's pork import policies are measured by using an annual multimarket econometric livestock sector model. This 53-equation model contains three simultaneous blocks corresponding to the pork, beef, and poultry markets. The blocks are linked by a retail meat demand system that includes pork, Wagyu beef, import-quality beef (dairy beef and imported beef combined), poultry, and fish expenditures.

Figure 2 provides a schematic representation of the pork subsector in the multimarket model. The subsector has two main systems: (1) live animal supply (sow inventory, *SOWH;* hogs raised, *HOGR;* and barrow and gilt inventory, *BAGH*) and demand (hogs slaughtered, *HOGSL*) and (2) meat supply (pork production, *PORS;* and pork imports, *PORM*) and demand (pork consumption, *PORD*). The beef and chicken subsectors are modeled by following the same general structure. The data sources used for the model are discussed in the appendix.[2] The estimated parameters, t-statistics, and elasticities are shown in Table 2. Variable definitions are presented in Table 3.

The Hog and Pork Subsector

As shown in Table 2, the hog and pork subsector includes behavioral equations for breeding herd inventories, *SOWH*; barrow and gilt inventories, *BAGH*; the margin between wholesale and farm price, *HOGMW*; the margin between wholesale and retail prices, *PORMR*; and the wholesale pork carcass price, *HOGPC*. Identities calculate the number of hogs raised, *HOGR*; the number of hogs slaughtered, *HOGSL*; the farm price of hogs, *HOGPF*; the retail price of pork, *PORPR*; pork production, *PORS*; expenditures on pork, *PORE*; per capita disappearance of pork, *PORD*; pork

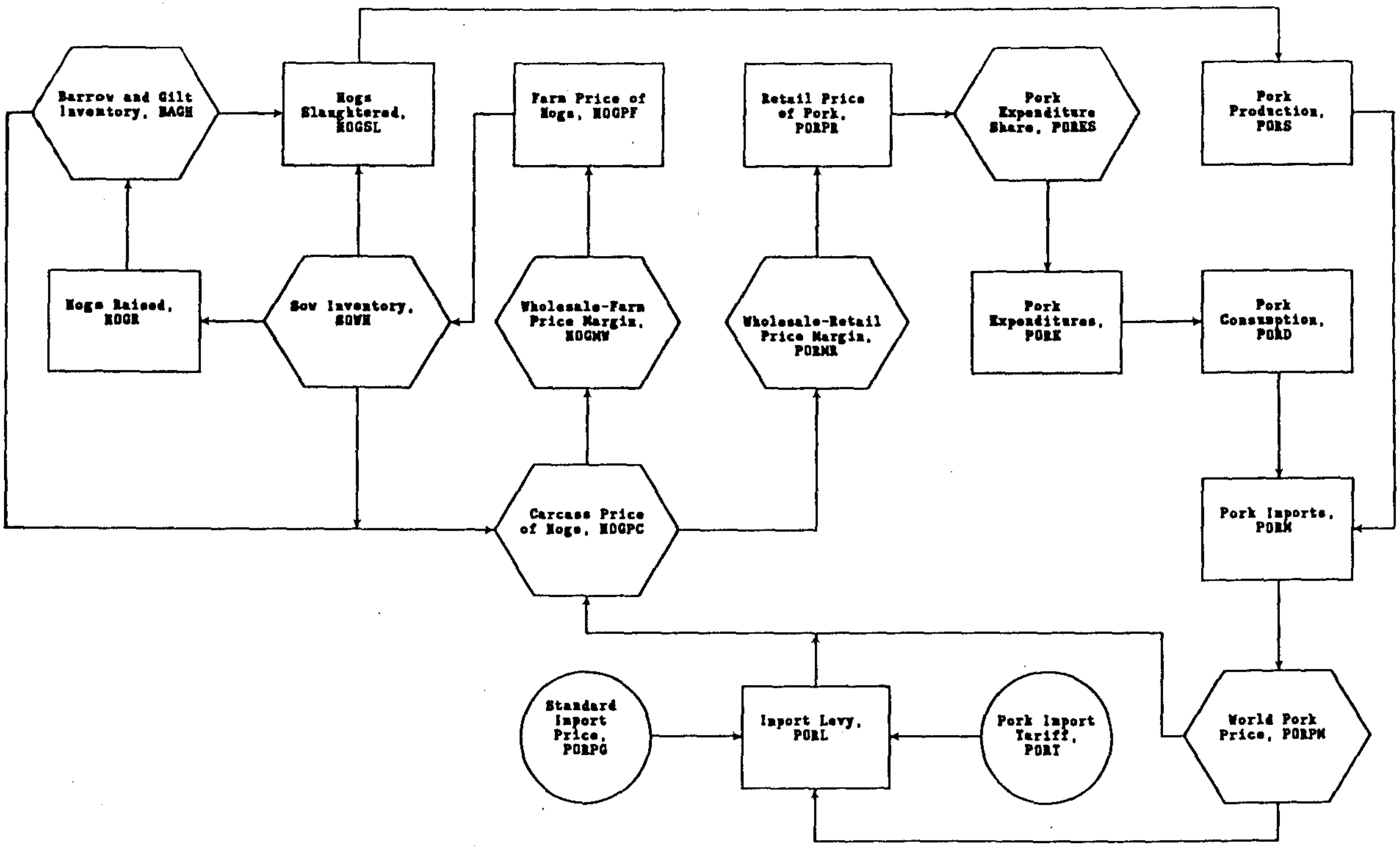


Figure 2. Pork subsector of the Japanese livestock model

Table 2. The Japanese livestock industry model

Hog and Pork Subsector

(2) $SOWH = 115.91 + 5.361\ (HOGPF/CORP) + 0.968\ SOWH_{t-1} - 0.194\ SOWH_{t-2}$

(1.22) (0.86) (5.13) (-1.29)

[0.059] [0.964] [-0.192]

$+ 4.331\ (PORPG/CORP)$ — $R^2 = 0.94$

(2.06) — $DH = 0.59$

[0.0714]

(3) $HOGR = PIGR \bullet SOWH_{t-1}$

(4) $BAGH = 892.56 + 0.422\ HOGR$ — $R^2 = 0.97$

(0.82) (7.63) — $DW = 2.31$

[0.893] — $\rho = 0.81$

(5) $HOGSL = SOWH_{t-1} + BAGH_{t-1} + HOGR - SOWH - BAGH + HOGM$

(6) $HOGMW = 18.001 + 0.322\ HOGPC + 8.247\ WPI$ — $R^2 = 0.91$

(1.47) (10.23) (0.96) — $DW = 2.19$

[0.254] [0.063]

(7) $HOGPF = HOGPC - HOGMW$

(8) $PORMR = -103.64 + 0.62\ HOGPC + 282.5\ WPI$ — $R^2 = 0.96$

(-2.25) (5.87) (8.90) — $DW = 1.19$

(9) $PORPR = HOGPC + PORMR$

(10) $HOGPC = 977.80 + 0.22\ 3\ PORPG - 0.050\ (SOWH_{t-1} + BAGH_{t-1})$

(2.19) (0.85) (-2.06)

[0.210] [-0.757]

$0.119\ (PORPM + PORL) - 0.62\ HOUH_{t-1}$ — $R^2 = 0.81$

(0.84) (-1.13) — $DW = 0.92$

[0.148] [-0.285]

(11) $PORS = HOGQ \bullet HOGSL$
(12) $PORE = PORES \bullet MEAE$
(13) $PORD = (PORE/POP)/PORPR$
(14) $PORM = PORD - PORS$

(15) $PORL = PORPG/C3 - PORPM,\ \text{if } PORPM < [PORPG/(1 + PORT)]$
$PORL = PORPM \bullet PORT,\ \text{if } PORPM \geq [PORPG/(1 + PORT)]$

(16) $PORTE = [HOGPC - (C3 \bullet PORPM)]/(C3 \bullet PORPM)$
(17) $LN(PORPM) = 1/30\ LN(PORM)$

Table 2. (continued)

Cattle and Beef Subsector

(18) $$WCHH = \underset{(3.0)}{357.0} + \underset{\substack{(.10)\\[0.008]}}{0.042}\,(WSTPC/WFDP) + \underset{\substack{(6.07)\\[1.069]}}{1.068}\,WCHH_{t-1} - \underset{\substack{(-5.17)\\[-0.749]}}{0.747}\,WCHH_{t-2}$$

$$+ \underset{\substack{(1.73)\\[0.113]}}{1.717}\,WDRFT - \underset{\substack{(-0.48)\\[-0.023]}}{0.349}\,WDRFT_{t-1} + \underset{\substack{(2.90)\\[0.054]}}{0.418}\,WABPG/WFDP \qquad R^2 = 0.95,\ DH = -.82$$

(19) $$WACR = WCALR \bullet WCHH_{t-1}$$

(20) $$WSHH = \underset{(1.77)}{130.59} + \underset{\substack{(7.56)\\[0.594]}}{0.38}\,(WACR + WACR_{t-1} + WACR_{t-2}) + \underset{\substack{(5.41)\\[0.264]}}{13.88}\,WSHFED \qquad R^2 = 0.81,\ DW = 0.99$$

(21) $$WACSL = WCHH_{t-1} + WSHH_{t-1} + WACR - WCHH - WSHH - CAWSL$$

(22) $$WABS = WACQ \bullet WACSL$$

(23) $$WABD = C1\,(WABS + VEWS)$$

(24) $$WABE = (BEEPR \bullet WABD)/POP$$

(25) $$WABES = WABE/MEAE$$

(26) $$WABMR = WABPR - WSTPC$$

(27) $$WSTPC = \underset{(1.63)}{169.7} + \underset{\substack{(9.18)\\[0.876]}}{0.5457}\,BEEPR - \underset{\substack{(-1.39)\\[-0.063]}}{0.023}\,(WCHH_{t-1} + WSHH_{t-1} + DCHH_{t-1} + DSHH_{t-1})$$

$$- \underset{\substack{(-1.5)\\[-0.025]}}{0.066}\,HOUW_{t-1} + \underset{\substack{(1.98)\\[0.070]}}{0.183}\,BEEPM + \underset{\substack{(1.61)\\[0.0412]}}{0.065}\,WABPG \qquad R^2 = 0.99,\ DW = 1.89$$

(28) $$DCHH = \underset{(2.48)}{236.77} + \underset{\substack{(1.76)\\[0.047]}}{0.75}\,(DSTPC/DFDP) + \underset{\substack{(7.86)\\[1.349]}}{1.35}\,DCHH_{t-1} - \underset{\substack{(3.40)\\[-0.563]}}{0.565}\,DCHH_{t-2}$$

$$+ \underset{\substack{(1.14)\\[0.107]}}{1.93}\,(MILPF/DFDP) - \underset{\substack{(-1.10)\\[-0.074]}}{1.337}\,(MILPF_{t-1}/DFDP_{t-1})$$

$$+ \underset{\substack{(1.65)\\[0.022]}}{0.425}\,DABPG/DFDP \qquad R^2 = 0.98,\ DH = -.62$$

(29) $$DACR = DCALR \bullet DCHH_{t-1}$$

(30) $$DSHH = -\underset{(-4.14)}{495.71} + \underset{\substack{(13.94)\\[1.429]}}{1.004}\,(DACR + DACR_{t-1}) \qquad R^2 = 0.89,\ DW = 1.27$$

Table 2. (continued)

(31) $DACSL = DCHH_{t-1} + DSHH_{t-1} + DACR - DCHH - DSHH - CADSL + CATM$

(32) $DABS = DACQ \bullet DACSL$

(33) $DABD = C2\ (DABS + BEEM/C2 + VEDS + BEEHG_{t-1} - BEEHG)$

(34) $DABE = (BEEPR \bullet DABD)/POP$

(35) $DABES = DABE/MEAE$

(36) $DABMR = DABPR - DSTPC$

(37) $DSTPC = \underset{(2.97)}{125.4} + \underset{\substack{(21.61)\\ [0.871]}}{0.545}\ WSTPC$ $\qquad R^2 = 0.95$, $DW = 1.92$

(38) $BEEPR = \underset{(46.92)}{-61.28} + \underset{\substack{(.033)\\ [1.025]}}{0.957}\ (WABPR + DABPR)/2$ $\qquad R^2 = 0.98$, $DW = 1.65$

(39) $LN(BEEPM/USCPI) = \underset{(4.82)}{0.829} + \underset{\substack{(1.22)\\ [18.85]}}{0.053}\ LN(BEEM)$ $\qquad R^2 = 0.76$, $DW = 0.52$

(40) $BEETE = (DSTPC - C1\ BEEPM)/(C1\ BEEPM)$

Chicken and Chicken Meat Subsector

(41) $CHMS = \underset{(-2.62)}{-1549.9} + \underset{\substack{(1.32)\\ [0.041]}}{1.229}\ CHMPR/CORP + \underset{\substack{(3.69)\\ [0.584]}}{0.594}\ CHMS_{t-1} + \underset{\substack{(2.61)\\ [2.182]}}{24.82}\ TIME$ $\qquad R^2 = .997$, $DH = 1.27$

(42) $CHMPR = \underset{(-0.84)}{-128.06} + \underset{\substack{(7.22)\\ [1.1756]}}{3.502}\ CHMPM$ $\qquad R^2 = 0.626$, $DW = 1.19$

(43) $CHMM = \underset{(-1.73)}{-93.01} + \underset{\substack{(2.62)\\ [3.004]}}{4.558}\ CHMPM$ $\qquad R^2 = 0.37$, $DW = 0.45$

(44) $CHME = CHMES \bullet MEAE$

(45) $CHMD = (CHME \bullet POP)/CHMPR$

(46) $CHMM = CHMD - CHMS$

Fish Subsector

(47) $FISE = MEAE - WABE - DABE - PORE - CHME$

(48) $FISES = FISE/MEAE$

(49) $LN(MPI) = WABES \bullet LN(WABPR) + DABES \bullet LN(DABPR)$
$+ PORES \bullet LN(PORPR) + CHMES \bullet LN(CHMPR) + FISES \bullet LN(FISPR)$

Table 2. (continued)

Meat Demand System

(49)	*WABES* = 0.057	- 0.076 LN(WABPR)	+ 0.016 LN(DABPR)	+ 0.013 LN(PORPR)
	(36.92)	(1.09)		(0.87)
		[-2.38]	[0.393]	[0.400]
		{-2.48}	{0.26}	{0.24}

+ 0.027 LN(CHMPR)	+ 0.020 LN(FISPR)	- 0.016 LN(MEAE/MPI)	$R^2 = 0.92$
(2.75)	(1.73)	(-1.56)	$DW = 1.06$
[0.620]	[0.971]	[0.704]	$\rho = 0.362$
{0.19}	{0.08}	{0.75}	

(50)	*DABES* = 0.071	+ 0.160 LN(WABPR)	+ 0.001 LN(DABPR)	+ 0.004 LN(PORPR)
	(22.84)			(0.23)
		[0.237]	[-0.899]	[0.201]
		{0.44}	{-0.98}	{0.12}

- 0.040 LN(CHMPR)	+ 0.018 LN(FISPR)	+ 0.012 LN(MEAE/MPI)	$R^2 = 0.82$
(-4.00)	(1.07)	(0.60)	$DW = 2.70$
[-0.340]	[0.795]	[1.132]	$\rho = 0.362$
{0.03}	{0.07}	{1.51}	

(51)	*PORES* = 0.181	+ 0.013 LN(WABPR)	+ 0.004 LN(DABPR)	+ 0.057 LN(PORPR)
	(38.90)			
		[0.135]	[0.116]	[-0.483]
		{0.71}	{0.22}	{-0.72}

- 0.024 LN(CHMPR)	- 0.050 LN(FISPR)	+ 0.006 LN(MEAE/MPI)	$R^2 = 0.55$
(-1.60)	(-2.08)	(0.19)	$DW = 2.21$
[-0.037]	[0.269]	[1.038]	$\rho = 0.362$
{0.07}	{0.08}	{0.98}	

(52)	*CHMES* = 0.107	+ 0.027 LN(WABPR)	- 0.040 LN(DABPR)	- 0.024 LN(PORPR)
	(65.16)			
		[0.285]	[-0.259]	[-0.050]
		{0.42}	{0.04}	{0.05}

+ 0.018 LN(CHMPR)	+ 0.019 LN(FISPR)	+ 0.001 LN(MEAE/MPI)	$R^2 = 0.74$
(1.95)	(0.04)	(2.99)	$DW = 1.76$
[-0.730]	[0.753]	[1.003]	$\rho = 0.362$
{-0.91}	{0.12}	{1.15}	

(53)	*FISES* = 0.584	+ 0.020 LN(WABPR)	+ 0.018 LN(DABPR)	- 0.050 LN(PORPR)
		[0.035]	[0.031]	[-0.084]
		{0.90}	{0.46}	{0.31}

+ 0.019 LN(CHMPR)	- 0.008 LN(FISPR)	- 0.002 LN(MEAE/MPI)
[0.035]	[-1.010]	[0.996]
{0.62}	{-0.35}	{0.92}

Note: A lag of i periods is indicated by (t - i). T-statistics are in ( ). Structural elasticities with homogeneity and symmetry imposed are in [ ], and elasticities with homogeneity, symmetry, and net substitutability imposed are in {}.

Table 3. Definitions of variables

ρ	Autocorrelation correction term.
BAGH	Ending inventories of barrows and gilts (Jan. 31), 1,000 hd.
BEEHG	Ending inventories of government stocks of beef (Jan. 31), 1,000 mt.
BEEM	Net imports of beef, 1,000 mt.
BEEPM	Import unit value of beef, ¥/kg. Average of unit import values of beef from all sources, weighted by import shares.
BEEPR	Retail price of beef, ¥/kg.
BEETE	Tariff equivalent of the beef import quota, percent.
C1	Wagyu beef conversion factor, wholesale-retail conversion ratio • 0.98 waste factor.
C2	Import-quality beef conversion factor, wholesale-retail conversion ratio • 0.98 waste factor.
C3	Pork conversion factor, wholesale-retail conversion ratio • 0.98 waste factor.
CADSL	Slaughter of dairy calves, 1,000 hd.
CATM	Cattle imports, 1,000 hd.
CAWSL	Slaughter of Wagyu calves, 1,000 hd.
CHMD	Disappearance of chicken meat, 1,000 mt.
CHME	Per capita expenditures on chicken meat, ¥ 1,000.
CHMES	Chicken meat share of total meat expenditures, percent.
CHMM	Net imports of chicken meat, 1,000 mt.
CHMPM	World chicken price, ¥/kg.
CHMPR	Retail price of chicken meat, ¥/kg.
CHMS	Production of chicken meat (carcass weight), 1,000 mt.
CORP	Wholesale price of corn (Japan fiscal year, Mar/Apr) ¥/kg .
DABD	Disappearance of import-quality meat (dairy beef + imported beef + other beef), 1,000 mt.
DABE	Per capita expenditures on import-quality beef, ¥ 1,000.
DABES	Import-quality beef share of total meat expenditures, percent.
DABMR	Wholesale-retail dairy beef price margin.
DABPG	Government support price for dairy beef, ¥/kg.
DABPR	Retail price of dairy beef, ¥/kg.
DABS	Production of dairy beef (carcass weight), 1,000 mt.
DACQ	Average slaughter weight of dairy cattle, 1,000 kg/hd.
DACR	Number of dairy cattle raised, 1,000 hd. Calculated as dairy cattle and calf slaughter and ending inventories less beginning inventories.
DACSL	Slaughter of dairy cattle, 1,000 hd.
DCALR	Average calving rate of dairy cattle, calculated as $DACR/DCHH_{t-1}$.
DCHH	Ending inventories of dairy cows and heifers over 2 years old (Jan. 31), 1,000 hd.
DFDP	Price of a complete mixed feed for feeding dairy cattle, ¥/kg.
DSHH	Ending inventories of all dairy steers and all dairy heifers less than 2 years old (Jan. 31), 1,000 hd.
DSTPC	Dairy steer carcass price, ¥/kg.
FISE	Per capita expenditures on fish, ¥ 1,000.
FISES	Fish share of total meat expenditures, percent.
FISPR	Retail price of fish, ¥/kg.
HOGM	Net imports of live hogs, 1,000 mt.
HOGMW	Hog farm/wholesale price margins, ¥/kg.
HOGPC	Wholesale carcass price of pork, ¥/kg.
HOGPF	Farm price of hogs, ¥/kg.
HOGQ	Average slaughter weight of hogs, 1,000 kg/hd.

Table 3. Definitions of variables (continued)

HOGR	Number of hogs raised, calculated as hog slaughter and ending inventories less beginning inventories, 1,000 hd.
HOGSL	Slaughter of hogs, 1,000 hd.
HOUH	Number of households raising hogs (end of year), 1,000 farms.
HOUW	Number of households raising Wagyu cattle (end of year), 1,000 farms.
LN	Natural log.
MEAE	Total expenditures on meat, ¥ 1,000.
MILPF	Average farm price of milk, ¥/kg.
MPI	Meat price index.
PIGR	Average birth rate of hogs, calculated as $HOGR/SOWH_{t-1}$.
POP	Population, millions of inhabitants.
PORD	Disappearance of pork, 1,000 mt.
PORE	Expenditures on pork, ¥ 1,000.
PORES	Pork share of total meat expenditures, percent.
PORL	Import levy for pork, ¥/kg.
PORM	Net imports of pork, 1,000 mt.
PORMR	Pork wholesale-retail price margin.
PORPG	Standard import price for pork, ¥/kg (set by the Japanese government).
PORPM	World pork price, ¥/kg.
PORPR	Retail price of pork, ¥/kg.
PORS	Production of pork (carcass weight), 1,000 mt.
PORT	Pork import tariff, percent.
PORTE	Tariff equivalent of the pork variable levy, percent.
SOWH	Ending inventories of sows (Jan. 31), 1,000 hd.
TIME	Time trend, 1962 = 62, 1963 = 63, . . ., 1986 = 86.
USCPI	U.S. consumer price index, 1967 = 100.
VEDS	Production of dairy calf veal (carcass weight), 1,000 mt.
VEWS	Production of Wagyu calf veal (carcass weight), 1,000 mt.
WABD	Disappearance of Wagyu beef, 1,000 mt.
WABE	Per capita expenditures on Wagyu beef, ¥ 1,000.
WABES	Wagyu beef share of total meat expenditures, percent.
WABMR	Wholesale-retail Wagyu beef price margin.
WABPG	Government support price for Wagyu beef, ¥/kg.
WABPR	Retail price of Wagyu beef, ¥/kg.
WABS	Production of Wagyu beef (carcass weight), 1,000 mt.
WACQ	Average slaughter weight of Wagyu cattle, 1,000 kg/hd.
WACR	Number of Wagyu cattle raised, calculated as Wagyu cattle slaughter and ending inventories less beginning inventories, 1,000 hd.
WACSL	Slaughter of Wagyu cattle, 1,000 hd.
WCALR	Average calving rate of Wagyu cattle, calculated as $WACR/WCHH_{t-1}$.
WCHH	Ending inventories of Wagyu cows and heifers over 2 years old (Jan. 31), 1,000 hd.
WDRFT	Approximation of Wagyu cattle used for draft purposes, calculated as (number of draft cattle in 1950) • (number of horses in current year/number of horses in 1950) as suggested by Hayami and Ruttan (1985).
WFDP	Price of a complete mixed feed for fattening Wagyu cattle, ¥/kg.
WPI	Wholesale price index, 1967 = 100.
WSHFED	Average length of feeding period for Wagyu steers and heifers.
WSHH	Ending inventories of all Wagyu steers and all Wagyu heifers less than 2 years old (Jan. 31), 1,000 hd.
WSTPC	Wagyu steer carcass price, ¥/kg.

imports, *PORM*; the pork import levy, *PORL;* and the tariff equivalent of Japanese pork import policies, *PORTE.*

The specification of the hog breeding herd ending inventory, (2), follows an adaptive expectation, partial adjustment framework. The structural farm price elasticity for hogs is 0.059. The breeding herd inventory structural elasticity with respect to the government stabilization price is 0.0714. On the basis of (2), hog producers seem to be more responsive to changes in the government stabilization price for pork than to the market price for hogs.[3] In contrast to the structural breeding herd elasticities, the long-run pork supply elasticity is 0.5994 (Table 4). Equation (4) estimates the ending inventory of barrows and gilts as a function of the number of hogs raised. The wholesale carcass price of hogs, *HOGPC* in (10), is estimated as a function of the government pork stabilization price, lagged inventories of the breeding herd and barrows and gilts, the import unit value of pork plus the import levy, and the number of households raising hogs. The government manipulates the wholesale carcass price to affect producer prices by adjusting the stabilization price or by changing the import levy. The government also considers the beginning inventories of hogs and the number of households raising hogs when adjusting the wholesale price. Equation (6), the farm-wholesale price

Table 4. Long-run supply elasticities

	Hog Carcass Price	Wagyu Steer Carcass Price	Dairy Steer Carcass Price	Milk Price	Chicken Meat Price
Pork Supply	0.5994				
Wagyu Beef Supply		0.2570			
Dairy Beef Supply			0.4361	0.1442	
Chicken Meat Supply					0.0882

Note: The long-run elasticities are calculated as follows. The exogenous variables were held at their 1988 levels and the model was simulated until a base equilibrium was reached. The model was then shocked by increasing price by 1 percent. By comparing the new equilibrium to the base equilibrium, the percentage change in supply as a result of the 1 percent change in price, which is the long-run supply elasticity, can be calculated.

margin, is a function of the wholesale carcass price of hogs and the wholesale price index. The farm price of hogs, *HOGPF* in (7), is calculated as the wholesale price less the farm-wholesale price margin. The wholesale-retail price margin, *PORMR* in (8), is also a function of the wholesale carcass price of hogs and the wholesale price index. The retail pork price, *PORPR* in (9), is calculated as the wholesale carcass price of hogs plus the wholesale-retail price margin.

Pork imports, *PORM* in (14), are calculated as pork disappearance less pork production. If the import price is less than the gate price (the standard import price divided by one plus the import tariff), the pork import levy, *PORL* in (15), is calculated as the difference between the government pork price and the import price of pork. If the import price is greater than the gate price, the pork import levy is calculated as the import tariff times the import unit price. The relationship between pork imports and world pork price, *PORPM* in (17), was arbitrarily assumed to be such that a 30 percent increase in pork imports would cause a 1 percent increase in world prices.[4]

The Cattle and Beef Subsector

The cattle and beef subsector of the model includes both Wagyu and dairy production. The subsector includes behavior equations for breeding herd inventories for Wagyu cattle, *WCHH,* and dairy cattle, *DCHH;* steer and heifer inventories for Wagyu, *WSHH,* and dairy, *DSHH;* carcass prices for Wagyu steers, *WSTPC,* and dairy steers, *DSTPC;* retail beef prices, *BEEPR;* and beef import prices, *BEEPM.* Identities are included for the number of Wagyu cattle slaughtered, *WACSL,* and dairy cattle slaughtered, *DACSL;* consumption of Wagyu beef, *WABD,* and dairy beef, *DABD;* expenditures on Wagyu beef, *WABE,* and dairy beef, *DABE;* expenditure shares for Wagyu beef, *WABES,* and dairy beef, *DABES;* and wholesale-retail price margins for Wagyu beef, *WABMR,* and dairy beef, *DABMR.*

The breeding herd inventory, *WCHH* in (18), is also modeled by following an adaptive expectations, partial adjustment framework and includes the number of Wagyu cattle used for draft purposes as an exogenous variable to account for the gradual change from using Wagyu cattle for draft purposes to using them for beef production. As with the hog breeding herd equation, the government stabilization price of Wagyu steer carcasses is included to more accurately reflect the responsiveness of producers to government policy.[5] The structural elasticities for the Wagyu breeding herd with respect to Wagyu price and the government support price are 0.008 and 0.054, respectively. The long-run supply elasticity for Wagyu beef is 0.257.

The number of Wagyu calves raised, *WACR* in (19), is calculated as the Wagyu calving rate times the beginning inventory of the Wagyu breeding herd. Equation (20) explains Wagyu steer and heifer inventories, *WSHH*, as a function of the number of calves raised and the length of the feeding period (*WSHFED*).

Equations (21) through (26) are identities that calculate Wagyu cattle slaughter (*WACSL*), Wagyu beef supply (*WABS*), Wagyu beef disappearance (*WABD*), expenditure per capita (*WABE*), expenditure share (*WABES*), and the Wagyu beef wholesale-retail price margin (*WABMR*). The variable *C1* in (23) is the conversion ratio from wholesale carcass basis to retail cuts basis and is adjusted to include a 2 percent waste factor. The variables *C2* and *C3* are the conversion factors for imported beef and imported pork, respectively.

Wagyu steer carcass price, *WSTPC* in (27), is estimated as a government policy function. The price is manipulated by the Japanese government to stabilize prices and protect producer incomes. Policymakers focus on the retail beef price, beginning inventories of Wagyu and dairy cattle, the number of households raising Wagyu cattle at the beginning of the period, the unit value of beef imports, and the announced Wagyu beef stabilization price. The government stabilization price of

Wagyu beef, the buying and selling of government stocks of beef, and the beef import quota are the tools that the government uses to manipulate the Wagyu steer carcass price.

Equation (28) explains the dairy cattle breeding herd, *DCHH*. The estimated equation is similar to the Wagyu breeding herd equation except that the milk price is included. Dairy cattle producers are more responsive to market price changes than are Wagyu producers. The estimated structural elasticities for the breeding herd with respect to the real dairy steer carcass price, the real farm price of milk, and the real government price are 0.047, 0.107, and 0.022, respectively. Thus, a one-unit change in the producer price of milk will have a greater effect on dairy breeding inventories than will a one-unit change in either dairy steer carcass price or the government stabilization price. However, dairy beef supply is more responsive in the long run to dairy steer price than to milk price. The long-run elasticities are 0.4361 and 0.1442, respectively.

Equation (29) calculates the number of dairy calves raised, *DACR*. Equation (30) estimates the dairy steer and heifer inventories, *DSHH*, as a function of the number of calves raised during the current period and during the period just before the current period. Equations (31) through (36) are identities that calculate the number of dairy cattle slaughtered (*DACSL*), the supply of dairy beef (*DABS*), the disappearance of import-quality beef (*DABD*, the combination of domestic dairy beef and imported beef), import-quality beef expenditures (*DABE*), import-quality beef expenditure share (*DABES*), and the dairy beef wholesale-retail price margin (*DABMR*). Domestic dairy beef and imported beef are assumed to be equivalent in the model.

Dairy steer carcass price, *DSTPC* in (37), is estimated as a function of the Wagyu steer carcass price. Retail beef price, *BEEPR* in (38), is estimated as a function of the average of the Wagyu and dairy beef prices.

The relationship between the price of imported beef (*BEEPM*) and beef imports (*BEEM*) is estimated by (39). The estimated flexibility is 0.053. The calculated elasticity is 18.85. The beef import tariff, *BEETE* in (40), is calculated as the difference between dairy steer carcass price and the world beef price, relative to the world beef price.

The Chicken and Chicken Meat and Fish Subsectors

Chicken meat production, *CHMS* in (41), is a function of the retail price of chicken meat divided by the price of corn, lagged chicken meat production, and time. The structural supply elasticity with respect to chicken meat price is 0.041. The long-run chicken meat supply elasticity is 0.0882. Time is a proxy for technical change. Chicken meat price, *CHMPR* in (42), is a function of the import price of chicken meat. Chicken meat imports, *CHMM* in (43), are a function of the import price of chicken meat (*CHMP*). The elasticity with respect to the import price is 3.004. Equations (44) through (46) calculate chicken meat expenditures (*CHME*), chicken meat demand (*CHMD*), and chicken meat imports (*CHMM*).

Expenditures on fish, *FISE* in (47), are calculated as total meat expenditures less the sum of expenditures on other meats. Equation (48) calculates fish expenditure share (*FISES*). The meat price index, (49), is calculated by following Stone's Price Index.

Retail Demand

The meat demand system uses an Almost Ideal Demand System (AIDS) specification. The estimated parameters of the meat demand system, with symmetry and homogeneity imposed, are presented in Table 2. The parameters used for simulation also had net substitutability imposed (see Hayes, Wahl, and Williams 1990). The calculated demand elasticities with symmetry, homogeneity, and net substitutability imposed are also presented.

Impacts of Liberalization

To assess the likely impacts of liberalizing the Japanese pork market, the full model of the Japanese livestock sector was simulated for the 1989 to 2000 period.[6] Two alternative policies are considered. First, tariffication of Japan's pork import policies is examined. The tariff equivalent of the policies is reduced over a ten-year adjustment period by using a one-tenth reduction per year beginning in 1991 from a base tariff equivalent calculated by using the average prices for the 1986-88 period. U.S. pork prices plus transportation, including a 10 percent profit margin, are used as the border price for comparison with Japanese domestic prices. The calculated base tariff equivalent is 44 percent (see Table 1). The second policy considered is complete liberalization of all pork import policies. This alternative assumes that the pork variable levy and import tariff are removed in 1991.

The baseline results assume that all Japanese pork import policies remain in place at 1990 levels and include the effects of the 1988 Beef Market Access Agreement (BMAA) to liberalize beef imports. Results labeled "Liberalization" in the figures and table that follow assume that Japanese pork markets are completely liberalized in 1991. The results labeled "Tariffication" assume that Japanese pork import policies are replaced with a tariff equivalent, which is reduced by one-tenth per year beginning in 1991. The changes in the simulated variables from baseline levels can be interpreted as impacts of liberalization upon the Japanese livestock industry.

The impacts of tariffication and liberalization on per capita pork consumption (carcass equivalent) are presented in Figure 3. In the tariffication scenario, per capita pork consumption increases by 6 percent the first year (1991) and continues to increase by about 4 percent per year through 2000, reaching a level approximately 34 percent greater than the baseline level in 2000. Under complete liberalization, per capita pork consumption increases by 20 percent in the first year and continues to increase annually to a level 34 percent greater than the baseline level in 2000. The

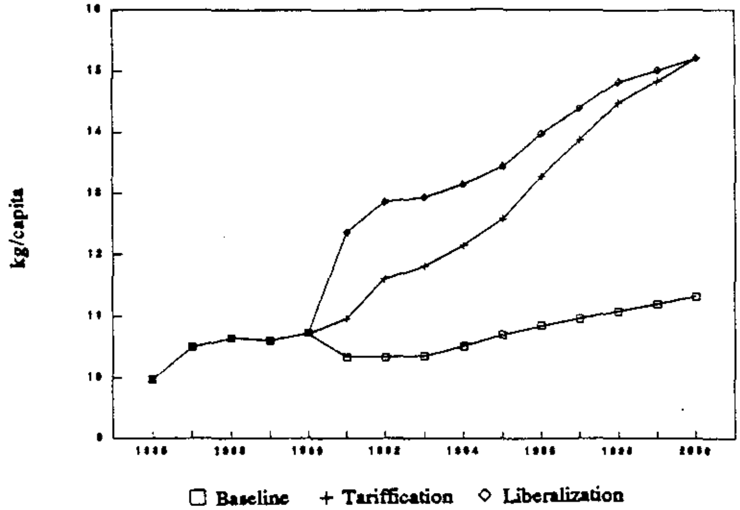


Figure 3. Pork disappearance per capita under tariffication and complete liberalization

large increases in pork consumption occur because of sharp decreases in retail pork price under both scenarios.

Tariffication results in an 8 percent decrease in retail pork price in the first year and a decline of more than 32 percent by 2000 (Figure 4). The decrease is caused by the lower domestic pork carcass price, linked to the world price by a declining tariff. As the tariff is reduced, the wedge between domestic and world prices decreases, resulting in dramatically lower retail pork prices. Under complete liberalization, the majority of the retail price adjustment occurs in the first year, decreasing by 22 percent and reaching a level 33 percent less than the baseline level by 2000.

The hog breeding herd inventory (sow inventory) decreases as pork prices decrease (Figure 5). The level of the sow inventory under the BMAA baseline assumption decreases because nominal government support prices for pork are assumed to remain constant. Under the assumption of tariffication of pork import policies, sow inventories initially decrease by about 2 percent and continue to decrease over the forecast period, reaching a level that is 25 percent less than the baseline

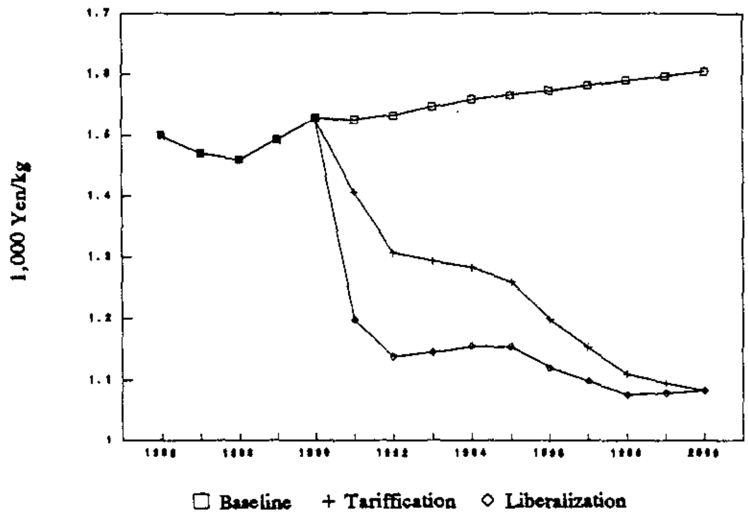


Figure 4. Retail pork price under tariffication and complete liberalization

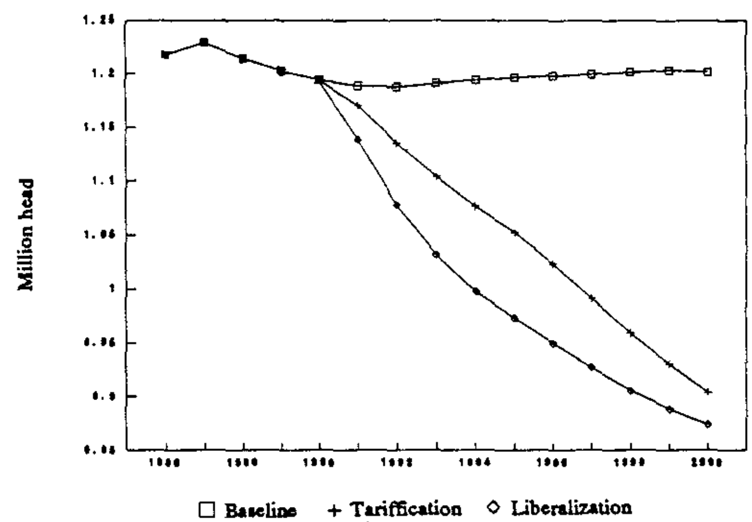


Figure 5. Hog breeding herd inventories under tariffication and complete liberalization

level in 2000. Under the assumption of complete liberalization, sow inventories decrease by approximately 5 percent in the first year and by almost 28 percent in 2000 relative to the baseline level.

Under tariffication, the resulting domestic pork supplies per capita (not shown) follow the decrease in the breeding herd, reaching a level approximately 22 percent less than the baseline level in 2000. Under complete liberalization, domestic pork supply is initially greater relative to pork supply under tariffication because of increased sow slaughter. By 2000, under complete liberalization, domestic pork supply is approximately 26 percent less than the baseline level and about 4 percent less than the level for the tariffication policy simulation. The combination of greater domestic consumption and less domestic production results in increased pork imports per capita. The initial increase in total pork imports is 39 percent and 125 percent under tariffication and liberalization, respectively (Figure 6). Pork imports continue to increase through 2000 and are 203 percent greater under tariffication and 215 percent greater under complete liberalization relative to

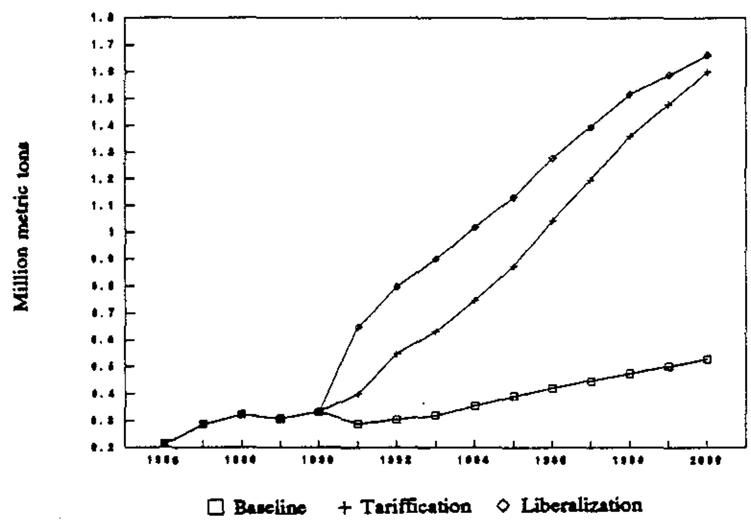


Figure 6. Japanese pork imports under tariffication and complete liberalization

baseline levels. Compared with 1990 levels, pork imports are projected to be more than 380 percent greater under tariffication and almost 400 percent greater under complete liberalization.

Beef imports are projected to be 8 percent less than the baseline level of 1.435 million mt under tariffication, declining to about 1.3 million mt by 2000. Tariffication of pork import policies results in a 20 percent decline in dairy beef prices and a 10 percent decrease in Wagyu beef prices. The effects upon the chicken sector are relatively insignificant. These cross effects illustrate the importance of developing tariffication policies and implementation strategies in multimarket contexts.

Compensation for Producers

Welfare Analyses

Under trade liberalization, the welfare of Japanese pork producers will decrease and consumer welfare will increase as prices decline. A scheme that compensates producers for welfare loss while allowing consumers to benefit from lower prices would permit trade liberalization to be politically acceptable to producers, consumers, and taxpayers.[7] A number of alternative policies, including a deficiency payment and an industry buffer scheme, could be used to compensate producers. This section discusses how these policies would change welfare in a static context and then presents dynamic results from the model.

Static Welfare Analysis

In a static framework under tariffication after the initial reduction, prices will decline from P_b to P_t, and quantity supplied will decrease from Q_b^S to Q_t^S as the tariff is reduced (see Figure 7). Pork demand will increase from Q_b^D to Q_t^D, and pork imports will increase from $(Q_b^D - Q_b^S)$ to $(Q_t^D - Q_t^S)$. Japanese producers will lose the area P_bacP_t, and consumers will gain the larger area P_bbfP_t. Government revenue from the tariff will be $(P_t - P_w) \cdot (Q_t^D - Q_t^S)$. Thus, under tariffication, taxpayers (consumers plus government revenue) could compensate producers and still increase their welfare relative to baseline levels.

A deficiency payment scheme could be used to compensate producers and maintain production at baseline levels. In Figure 7, the deficiency payment would be $(P_b - P_t) \cdot Q_b{}^S$ and would result in unchanged producer welfare. Producers would lose P_bacP_t under tariffication but would gain P_badP_t, less production costs equivalent to the triangle *acd* under the deficiency payment, and producer welfare would therefore remain unchanged. Consumer welfare under the deficiency payment would remain the same as that under tariffication. Net government revenues under the

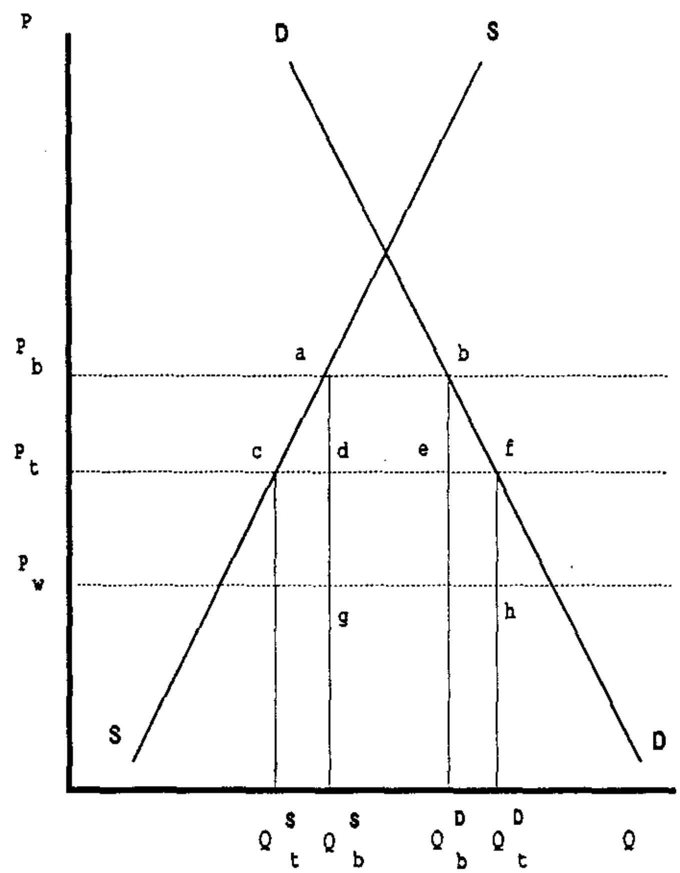


Figure 7. Changes in welfare measures under tariffication

deficiency payment scheme would substantially decrease as producers are compensated. However, net taxpayer welfare under the deficiency payment increases by *abfd* plus the tariff revenue, *dfgh*.

Government costs under a full deficiency payment program increase substantially over the forecast period. An alternative policy that buffers the adjustment of the pork industry may be more politically acceptable and may result in lower government costs. One such alternative policy is an industry buffer scheme that maintains producer prices at 1990 levels for two years by using a deficiency payment and then slowly reducing the level of the payments to producers. The two-year adjustment period allows producers a stable price until breeding decisions incorporate the imminent market price decline. After two years, changes within the pork industry are buffered by limiting producer price reductions with a declining deficiency payment. The declining deficiency payment is designed to restrict producer price decreases such that liquidation of the breeding herd is limited to a maximum of 5 percent per year. The declining deficiency payment is not triggered if market prices are such that production levels decline by less than 5 percent per year. Domestic wholesale market prices are still determined by using the import price plus the tariff. Thus, the industry buffer scheme allows production levels to decrease gradually, by no more than 5 percent per year, until equilibrium levels associated with the tariff reduction are reached. Although the methods and parameters for the industry buffer scheme are chosen arbitrarily, the policy is designed as an alternative that is more appealing to producers than is tariffication and less expensive than a full deficiency payment scheme.

Dynamic Welfare Analysis

The changes in welfare measures can be approximated in a dynamic framework by measuring areas above the supply curve and below the demand curve and then comparing the simulated results of the alternative policies to the baseline results.[8] As shown in Table 5, producer welfare under tariffication continues to decrease relative to the baseline over the forecast period. Complete liberalization results in an immediate loss in producer welfare. The deficiency payment scheme

Table 5. Changes in government revenues and producer, consumer, and taxpayer welfare under tariffication, complete liberalization, and a deficiency payment scheme

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Change in producer welfare					million yen					
Tariffication	(116,071)	(217,944)	(241,227)	(259,290)	(283,942)	(345,265)	(389,613)	(431,262)	(445,394)	(458,234)
Liberalization	(320,891)	(378,295)	(375,139)	(369,055)	(369,765)	(402,707)	(424,904)	(447,727)	(447,947)	(447,805)
Deficiency Payment	0	0	0	0	0	0	0	0	0	0
Industry Buffer	(28,077)	(122,327)	(247,726)	(267,555)	(290,846)	(350,927)	(393,934)	(434,500)	(447,685)	(459,850)
Change in consumer welfare										
Tariffication	141,410	277,325	315,810	353,126	403,062	514,780	607,000	702,865	752,043	801,370
Liberalization	416,024	512,603	526,451	540,319	563,295	640,314	699,801	763,325	782,484	800,763
Deficiency Payment	141,312	277,899	317,954	356,826	407,753	519,568	611,927	707,853	757,409	806,992
Industry Buffer	141,283	278,105	318,466	356,005	405,033	515,904	607,650	703,237	752,270	801,510
Change in net government revenues										
Tariffication	7,083	17,927	22,487	30,831	44,317	69,806	95,740	124,875	148,530	174,896
Liberalization	(61,166)	(77,100)	(82,764)	(92,285)	(103,611)	(122,088)	(138,050)	(154,769)	(164,653)	(174,896)
Deficiency Payment	(109,116)	(199,599)	(217,978)	(228,779)	(243,216)	(286,775)	(314,256)	(338,317)	(339,888)	(338,535)
Industry Buffer	(100,626)	(181,573)	26,089	34,850	47,047	71,273	96,424	125,125	148,561	174,821
Change in taxpayer welfare[a]										
Tariffication	148,493	295,252	338,297	383,957	447,379	584,586	702,740	827,741	900,573	976,266
Liberalization	354,858	435,504	443,687	448,033	459,683	518,226	561,752	608,556	617,831	625,867
Deficiency Payment	32,195	78,300	99,976	128,047	164,537	232,793	297,670	369,536	417,521	468,458
Industry Buffer	40,657	96,532	344,556	390,855	452,080	587,177	704,074	828,362	900,831	976,330

[a]Taxpayer welfare = consumer welfare + net government revenues.

results in unchanged producer welfare. Under the industry buffer scheme, producer welfare decreases by a relatively small amount compared to baseline levels during the first two years because prices to producers are held at 1990 levels. However, producer welfare then steadily declines for the rest of the forecast period. Consumer welfare steadily increases relative to baseline levels under all the alternative policies during the forecast period because retail prices steadily decline toward world price levels.

Net government revenues are projected to increase by more than 7 billion yen (U.S. $51 million) relative to the baseline in the first year of tariffication and by about 175 billion yen by the end of the forecast period. Under the deficiency payment scheme, however, net government revenues decrease by more than 109 billion yen (U.S. $807 million) relative to the baseline in the first year of the scheme. By the end of the forecast period, net government revenues decrease by 339 billion yen (U.S. $3.9 billion) under the deficiency payment scheme. Under the industry buffer scheme, net government revenues decline in the first two years as prices are supported at 1990 levels by a deficiency payment. As the deficiency payment begins to decline after the initial two-year period, however, the tariff revenue outweighs the cost of payments to producers and net government revenues become positive. Taxpayer welfare increases relative to the baseline under all the alternative policies.

Under all the alternative policies, Japanese self-sufficiency in pork would decrease. To the extent that Japanese consumers are concerned about the risk of pork scarcity caused by international disputes, the consumer welfare measures presented overstate the consumer benefits.

Summary and Conclusions

Japan represents one of the most promising markets for pork exports, but Japanese pork imports are currently restricted by a complex combination of a variable levy and an ad valorem import tariff. Recent liberalization of beef imports suggests that Japan's pork markets may also be liberalized. Tariffication has been proposed to the GATT by the United States as a method of quantifying trade barriers and providing a basis for reducing them over time. The results indicate that, under tariffication, per capita pork consumption in Japan may increase by 6 percent initially and by 34 percent by 2000. Pork prices are projected to decrease by more than 30 percent by the end of the forecast period. Pork imports may increase by 39 percent initially and are projected to reach a level 380 percent greater than the 1990 level by 2000.

Producer welfare can be maintained at preliberalization levels by using a deficiency payment scheme, but this scheme has a high government cost. A less costly alternative is an industry buffer scheme that consists of maintaining 1990 pork industry levels for two years and then implementing a declining deficiency payment designed to limit the decrease in production levels to 5 percent per year. Under the industry buffer scheme, tariff revenue exceeds the cost of the payments to producers and results in positive net government revenues after the second year of the policy. Calculated Japanese taxpayer welfare under the industry buffer scheme is similar to the results under tariffication by the end of the forecast period.

APPENDIX

The data used in this study are from various yearbooks and reports published by the Japanese Ministry of Agriculture, Forestry, and Fisheries (MAFF) including various issues of *Statistical Yearbook, Statistics of Meat Marketing, Meat Statistics in Japan, Monthly Statistics of Agriculture, Forestry, and Fisheries,* and the *Annual Report on the Family Income and Expenditure Survey.* Inventory data for live animals, slaughter numbers, slaughter weights, prices paid to farmers, wholesale prices, and wholesale-to-retail conversion factors are from the *Statistical Yearbook.* Retail prices for pork and chicken meat are from *Meat Statistics in Japan.* Expenditures are calculated as price times disappearance (retail basis). Disappearance for Wagyu beef, import-quality beef, pork, and chicken meat are calculated as production plus imports, the data for which are available from the *Statistical Yearbook.* Data for consumer, wholesale, and producer price indexes, family income, retail fish disappearance, and household family size are also available from the *Statistical Yearbook.* Retail fish price, from the *Annual Report on the Family Income and Expenditure Survey,* is an average of fresh and salted fish price series weighted by the disappearance of each.

A retail beef price is available in *Meat Statistics in Japan* or the *Statistical Yearbook,* but individual retail prices for Wagyu and dairy beef are not published. Retail Wagyu and dairy beef prices are calculated by multiplying by 2.1156 the respective wholesale prices available in *Statistics of Meat Marketing* and *Meat Statistics in Japan.* This coefficient is the average ratio of total retail beef expenditures to the sum of wholesale Wagyu beef expenditures and wholesale dairy beef expenditures.

Prices for U.S. pork are taken from the U.S. Department of Agriculture publication *Market News*. The wholesale pork price is calculated as the farm price plus the reported farm-to-wholesale marketing margin.

ENDNOTES

1. For a historical discussion of Japanese meat consumption habits, see Yoshida and Klein (1990).

2. The model was estimated over the 1965-87 period.

3. For a detailed discussion of the use of both government and market prices in a supply equation, see Hayes and Wahl (1989).

4. The assumption is based upon an informal survey of brokers at the Chicago Mercantile Exchange.

5. See Hayes and Wahl (1989).

6. Actual data are used for all variables through 1989 and for most variables through 1990. Data for ending inventories in 1990 were not available. Forecasts of the exogenous variables used in the policy simulations are based upon the forecasts of the Food and Agricultural Policy Research Institute (1991).

7. For a discussion of the welfare implications of quotas and deficiency payments, see Hayami (1979) or Anderson (1983).

8. For ease of calculation, linear supply and demand curves with slopes of 45° and -45°, respectively, are assumed.

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