The Exchange Rate Pass-through into Import Prices: The Case of Japanese Meat Imports

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1. Introduction

When the domestic currency depreciates, the prices of goods imported into that country are typically expected to rise. What exactly will be the response of domestic price is an empirical question. For instance, the response of domestic currency price is relatively small if foreign producers absorb the exchange rate movements in their profit margin in order to maintain their market share in that (importing) country. The extent of this so called "exchange rate pass-through" into import prices therefore may be complete, partial, or negligible (Campa and Goldberg 2005). However, it is reasonable to say that, under *ceteris paribus* condition, the exchange rate induced increases in import prices will generally improve the competitiveness of domestic producers in most industries relative to that of foreign competitors. Numerous studies have examined the extent to which exchange rate changes affect the prices of internationally traded goods. Most of these studies focused on US imports from all sources (*e.g.*, Campa and Goldberg 2005; Feinberg 1989; Yang 1997) or just one specific country (*e.g.*, Bernhofen and Xu 2000; Blonigen and Haynes 2002). The common denominator in all of these studies is that they all used composite exchange rates, *i.e.*, the aggregate trade-weighted exchange rates that are generally computed by the Board of Governors of the Federal Reserve System for the aggregate economy. However, the research by Goldberg (2004) and Pollard and Coughlin (2006) indicate how the exchange rate pass-through estimates are sensitive to the exchange rate index utilized. In other words, if one sets out to measure the exchange rate pass-through for certain industry or commodity, the use of the aggregate trade-weighted exchange rates may not be appropriate and is likely to yield significantly different estimates than if the industry or commodity trade-weighted exchange rate is utilized.

A few studies have been conducted to measure the exchange rate pass-through at a commodity level in agricultural trade. Those studies that did address the effects of exchange rates on the prices of internationally traded agricultural goods did that primarily from the stand point of exporting countries focusing on the pricing to market (PTM) as defined by Knetter (1989, 1993). Some of the more notable studies addressing the PTM question in international trade of agricultural commodities are Pick and Park (1991), Park and Pick (1996), Carew (2000), or Miljkovic, Brester, and Marsh (2003). The bias towards studying the PTM almost exclusively in agricultural trade literature is not accidental since all of these studies originated in developed net-exporting nations of agricultural commodities such as the United States or Canada. However, there are many both developed and developing nations that are net importers of agricultural commodities and the imports side of the problem is of more interest to them. Moreover with trade liberalization via the General Agreement on Tariffs and Trade (GATT), the World Trade organization (WTO), and many regional free trade agreements, many traditional exporters of agricultural commodities have increased drastically their food imports and thus have an increased interest in this type of analysis as well.

Japan is one of the world's largest net importers of food products (USDA PS&D, 2006 ?) and world's largest net importer of the meat products including beef, pork, and poultry (Miljkovic, Brester, and Marsh 2003; FAOSTAT 2006). Although Japan is a large net importer of meat products, it has sizeable production of these commodities on its own (FAOSTAT 2006). Being single largest importer of meat products, studying Japan is certainly of interest to meat exporting nations. How the fluctuations in exchange rates will affect domestic import prices of meat products in Japan and in turn the competitive position of domestic producers is certainly a question of interest to meat exporting countries and Japanese producers, importers, and consumers. The objective of this study is to estimate the extent of the exchange rate pass-through on the domestic (Japanese) prices of the commodities under consideration including beef, pork, and poultry meat. Meats imports weighted exchange rates rather than aggregate trade or aggregate imports weighted exchange rates are utilized in the analysis based on recommendation from Goldberg (2004) and Pollard and Coughlin (2006). Finally, implications of the exchange rate fluctuations as well as other relevant variables on the Japanese domestic prices of meat products are discussed.

The paper is organized as follows. Section 2 provides an overview of the meat production, consumption, and trade in Japan over the past two decades. Section 3 derives the empirical model used for this study. The next section discusses data and estimation methods, and section 5 presents estimation results and discusses our findings. The final section presents conclusions of the paper.

2. Japanese Meat Imports

Japanese production, consumption, and imports of beef, pork, and poultry meat over the period from 1985 to 2005 are summarized in Table 1.

(INSERT TABLE 1 HERE)

Japanese meat exports are minor and negligible, and thus not reported in the table. While production of beef, pork, and poultry meat in Japan has decreased slightly over time, consumption of all the three types of meat has increased steadily over the years. As a result, Japanese meat imports have increased rapidly over time.

Japanese beef production has been quite stable over the past two decades. Beef production has been around a mean of 547.4 thousand tons with a standard deviation of 36.6 thousand tons. The beef production was 555 thousand tons in 1985 and reduced to 500 thousand tons in 2005, an average annual decrease of 0.52%. Beef consumption has increased rapidly from 780 thousand tons in 1985 to 1585 thousand tons in 2000, a record high in history. In recent years, however, Japanese beef consumption declined due to the negative effects that the incidences of mad cow disease around the world had on perception of Japanese consumers and due to government imposed bans on beef imports from Canada and the United States. With a similar change pattern to beef consumption, Japanese beef imports has increased steadily from 216 thousand tons in 1985 to 1067 thousand tons in 2000 and then declined in recent years. Figure 1 clearly shows the change patterns of Japanese beef production, consumption and imports in Japan over the period from 1985 to 2005. The change patterns of beef consumption and imports are very similar and the correlation coefficient between the two series is 0.983.

(INSERT FIGURE 1 HERE)

The major countries from which Japan imports beef include Australia, the United States, Canada, and New Zealand. According to the Monthly Statistics of the Agriculture & Livestock Industries Corporation (ALIC) in Japan, Japanese monthly beef imports from these four countries accounted for an average of 99.3% of its total beef imports, with a standard deviation of 0.80% during the period from November 1996 to January 2006. Japan has stopped its beef imports from Canada since July 2003 and banned imports from the United

States since February 2004 due to the alert of mad cow disease found in Alberta, Canada in May of 2003 and in the state of Washington, USA, in December of 2003. Japan has simply diverted its beef imports to the other two countries, New Zealand and, particularly, Australia.

Japanese pork production has declined constantly from 1531 thousand tons in 1985 to 1266 thousand tons in 1996, and the production has become relatively stable afterwards as indicated in Table 1. Pork production in 1996 – 2005 was around the mean of 1264 thousand tons with a standard deviation of 16.9 thousand tons. The average annual decrease of pork production over the entire period under study is about 1.03%. By contrast, pork consumption in Japan increased from 1750 thousand tons in 1985 to 2507 thousand tons in 2005, an average annual increase of 1.81%. Due to decreased production and increased consumption, Japanese pork imports have increased steadily from 272 thousand tons in 1985 to 1339 thousand tons in 2005, an average annual increase of 8.30%. Figure 2 indicates that by the year 2005, imported pork represented more than 50% of the total Japanese consumption. The correlation coefficient between the two series of pork consumption and imports is 0.955.

(INSERT FIGURE 2 HERE)

Japanese pork imports are mainly sourced from the United States, Demark, Canada, and South Korea. From November 1996 to January 2006, monthly pork imports in Japan from these four countries accounted for an average of 82.6%, with a standard deviation of 8.92%. Japan banned imports of pork from South Korea since May 2000 due to the reported occurrence of foot-and-mouth diseases (FMD) in South Korea. Japan simply diverted its imports of pork to the other three major pork trading partners. In recent years, about one third of Japanese pork imports are sourced from the United States.

Japanese poultry meat production has declined steadily from 1270 thousand tons in 1985 to 1074 thousand tons in 2001, a record low in history (Table 1). Poultry meat production has started to increase slightly in recent years. The average annual decrease of poultry meat production over the entire period under study is about 0.43%. Poultry meat consumption in Japan has increased constantly from 1345 thousand tons in 1985 to 1880 thousand tons in 2005, an average annual increase of 1.69%. Since the gap between consumption and production has increased over time, Japanese poultry meat imports have increased rapidly from 100 thousand tons in 1985 to 748 thousand tons in 2005, an average annual increase of 10.6%. The consumption of imported poultry represents about 40% of the total consumption of poultry in year 2005 (Figure 2). The correlation coefficient between the two series of poultry meat consumption and imports is 0.922.

Poultry meat imports in Japan are mainly sourced from China, the United States, Brazil, and Thailand. From November 1996 to January 2006, monthly imports of poultry meat in Japan from these four countries accounted for an average of 98.9%, with a standard deviation of 0.89%. Due to the occurrence of bird flu in Thailand and China in January 2004, Japan has essentially stopped imports of poultry meat from China and Thailand since February 2004 and has diverted its imports to the other two major countries, particularly Brazil.

To emphasize, Figure 2 shows that the share of imported meat in meat consumption in Japan has increased over time for all three types of meat under study. This suggests that the importance of meat imports in Japan increased substantially over the last two decades..

3. Empirical Model

The law of one price states that in the absence of transportation and other transaction costs, competitive markets will equalize the prices of an identical good in two countries when the prices are expressed in the same currency. In mathematical notation, the law of one price can be expressed as follows:

$$p^H = e \; p^F \qquad (1)$$

Where p^H and p^F represent the prices at the home and foreign countries, respectively, and e is the exchange rate in price quotation system, which defines the exchange rate as the number of units of domestic currency per unit of foreign currency (i.e. the price of foreign currency in terms of domestic currency)[1].

Given transportation costs and the imperfect competitive world market, the absolute version of the law of one price as expressed in equation 1 is very unlikely to hold. However, the following relative version of the law of one price may hold:

$$p^H = \alpha \; e \; p^F \qquad (2)$$

Where α indicates the deviation from the law of one price, and is constant over time.

Following Campa and Goldberg (2005) and Pollard and Coughlin (2006), let the foreign price of a good p^F be determined by the markup over marginal cost. Markup is a function of industry-specific factors ϕ, and the general macroeconomic conditions, which is proxied by the exchange rate e. Marginal cost is determined by demand for good x and the cost of inputs w. Demand, in turn, is a function of the price of substitute goods, *y*, in the home country p^y, and consumer expenditures on goods x and y in the home country I^H. Making these substitutions and rewriting equation 2 in natural logarithm form, we get:

[1] By contrast, the volume quotation system defines the exchange rate as the number of foreign currency per unit of domestic currency, which is just the reciprocal of the exchange rate in price quotation system.

$$ln\,p^{H} = ln\,\alpha + ln\,e + ln\,Markup^{F} + ln\,MC^{F}$$

$$\rightarrow \quad ln\,p^{H} = ln\,\alpha + ln\,\phi + (1+\delta)ln\,e + c_0\,ln\,p^{y} + c_1\,ln\,w + c_2 \ln I^{H} \qquad (3)$$

If markup over marginal cost is constant (δ = 0), then the exchange rate pass-through is complete. This is the case of perfect competitive firms. If firms have market power and adjust their markup to fully offset the changes in the exchange rate on the home price (δ = -1), then the exchange rate pass-through is zero. Typically, the world market is not a perfect competition market and firms adjust their markup to partially offset the changes in the exchange rate on the home price, and thus the exchange rate pass-through is typically incomplete (-1< δ < 0).

Monthly dummies are added to account for the lack of seasonally adjusted data. Also, we add dummies to account for the effects of the reported occurrence of mad cow diseases in North America, foot-and-mouth diseases in South Korea, and bird flu in China and Thailand, as we discussed earlier. The regression model corresponding to equation 3 is as follows:

$$ln\,p^{H} = \beta_0 + \beta_1\,ln\,e + \beta_2\,ln\,p^{y} + \beta_3\,ln\,w + \beta_4 \ln I^{H} + \sum_{k} \lambda_k\, Z_k + \varepsilon, \qquad (4)$$

where Z_k is a vector of dummy variables as discussed above.

The expected sign for β_1 is positive since an increase in the exchange rate (e) means depreciation of the Japanese Yen, which translates into an increase of the import prices in Japan. The expected sign for β_2 is positive since an increase in the prices of the home substitutes (p^{y}) would shift the import demand curve outward and increase the prices of imported good, all other things being equal. The expected sign for β_3 is positive. Given the markup over the marginal cost remain unchanged, an increase in foreign input costs (w) would increase the foreign price of the good. The expected sign for β_4 is positive since an increase in consumer expenditures (I^H) would increase the price of imports, ceteris paribus.

4. Data and Estimation Method

The monthly time series data for import prices, import quantities by origin, the Japanese domestic prices, and per capita expenditure on beef, pork, and chicken are obtained from various issues of the Monthly Statistics of the Agriculture & Livestock Industries Corporation (ALIC). The data covers a period of 111 months from November 1996 to January 2006. The monthly time series of consumer price indices are obtained from the International Financial Statistics (IFS) database. The consumer price indices for Australia and New Zealand are not available on the monthly basis. Quarterly time series of the consumer price indices for the two countries are used instead. The monthly real exchange rates and U.S. producer prices (gross farm value) are obtained from the online database of the Economic Research Service of the U.S. Department of Agriculture (USDA). Producer prices for beef, pork, and poultry meat are obtained from the FAOSTAT database. Monthly pork imports from South Korea from November 1996 to October 1997 are not available and we use the averages derived from the annual imports for those months.

The import prices are based on the C.I.F. (cost, insurance and freight) prices at the Japanese border in terms of Japanese Yen per kilogram. Note that the import prices are the “total prices” from the Monthly Statistics of ALIC, which are the weighted average prices, with different cuts (e.g., bone-in-cuts and boneless-in-cuts for both fresh and frozen) as the weights. Japanese domestic beef prices are the weighted average retail normal selling prices at the national level. Eight monthly time series of normal selling prices for chuck, brisket, sirloin, and round for both Wagyu beef and other beef are reported in the Monthly Statistics of ALIC. Since the quantities are not available by beef type, we calculate the weighted average prices by giving each of the eight series an equal weight. Similarly, Japanese domestic pork prices are the weighted average prices of the normal selling prices for shoulder, loin, and leg at the national level. Japanese domestic poultry meat prices are the weighted average prices of the wholesale prices for broiler legs and breasts in Tokyo.

Three import-weighted real exchange rate measures by commodity are constructed based on Goldberg (2004) according to the following formula:

$$MER_t^i = \sum_c wt_t^{ic} RER_t^c \tag{5}$$

Where MER_t^i is the import-weighted real exchange rate for commodity i (i = beef, pork, poultry meat), $wt_t^{ic} = \frac{M_t^{ic}}{\sum_c M_t^{ic}}$ is the import weight assigned to foreign country *c*, RER_t^c is the real exchange rate between Japan and country *c* (*c* is the major countries from which Japan imports, as we discussed earlier).

Since the currency denomination varies significantly across the countries, the magnitudes of the monthly real exchange rates between Japan and each country also varies significantly across the countries. For example, the average real exchange rate between Japan and the United States during the period under study is 119.2 Yen per U.S. dollar, while that between Japan and Korea is 0.11 Yen per Korean Won. To overcome this problem, the monthly real exchange rates between Japan and each country are indexed based on December 2000 before they are plugged into formula 5 to obtain weighted average real exchange rate.

Similarly, three import-weighted producer price indices for beef, pork, and poultry meat are constructed according to the following formula:

$$w_t^i = \sum_c wt_t^{ic} PPI_t^{ic} \tag{6}$$

Where w_t^i is the import-weighted producer price index for commodity i (i = beef, pork, poultry meat), wt_t^{ic} is the same import weight used in equation 5, PPI_t^{ic} is the producer price index by commodity for country *c*, which equals to 100 in the year 2000.

Monthly producer prices for beef, pork, and poultry meat are not available for all countries, except the United States. We use annual time series data, assuming the nominal producer prices are constant within the year but vary over the years. Note that producer prices in real terms vary across the months since all prices are deflated by the monthly consumer prices indices.

We believe that cross equation error correlations are most likely within meat demand, since that is a behavioral representation for consumers. Therefore, we estimate the three equations for beef, pork, and poultry meat simultaneously. The iterative seemingly unrelated regression (ITSUR) method is used to take into account any cross-equation correlations. The noise components have the property $\varepsilon_i \sim (0, \sigma_{ii} I_n)$ and $\text{cov}(\varepsilon_i, \varepsilon_j) = \sigma_{ij} I_n$. That is, the error terms in a given equation are assumed to be homoskedastic and uncorrelated, and the errors in different equations are only contemporaneously correlated and the cross-equation correlation remains constant across time. The stacked vector of errors is not homoskedastic and uncorrelated due to the contemporaneous cross-equation correlation.

To justify our assumptions about the error terms in our simultaneous equations system, we conduct tests for normality and homoscedasticity. The system testing for normality includes Mardia's skewness and kurtosis tests (Marida 1970) and Henze-Zirkler test (Henze and Zirkler 1990). The normality test for each equation is Shapiro-Wilk W test (Shaprio and Wilk 1965). Homoscedasticity hypothesis is tested using White test.

4. Estimation Results and Discussion

The estimation results and the regression information, including adjusted R^2, White statistics, Shapiro-Will W statistic, and system normality, skewness, and kurtosis tests are summarized in Table 2. The normality test results and the White test statistic indicate that the residuals of our model do not violate normality and homoscedasticity assumptions.

All of the estimated key parameters have the expected signs. The estimated coefficient for the exchange rate variable that is of primary interest for us in this paper is statistically significant at a 1% significance level for the cases of beef and poultry meat. As expected, both cases indicate partial exchange rate pass-through although in the case of poultry the coefficient value of 0.943 implies that almost complete exchange rate pass-through exists. That indicates that the markup over marginal cost is almost constant and that this is the case of the almost perfect competition. On the other hand, the exchange rate coefficient in the beef equation is 0.504 clearly indicating the partial exchange rate pass-through. Finally, the exchange rate coefficient in pork equation, somewhat surprisingly, is zero in statistical terms indicating zero exchange rate pass-through.

The price coefficients of the home substitutes are all positive as expected, but are significant for beef and poultry only. It is especially indicative that home poultry elasticity of substitution is high with the estimated coefficient exceeding unitary elasticity. Further, an increase in foreign input costs increases the price of imports, *ceteris paribus*. This coefficient, although of the right sign in all equations, is significant in pork equation only. Finally, an increase in consumer expenditures/income leads to an increase in import prices, *ceteris paribus*. Again, this coefficient is of expected sign in all three equations, but it is significant only in the pork equation at 1% significance level.

The discussion on beef, pork, and poultry dummy variables is also of interest to us. Beef dummy implies the value of one for all observations between 1996:11 and 2003:7, when Japan first stopped beef imports from Canada due to mad cow disease outbreak in Canada, and zero after 2003:7 when the imports ban from either Canada or the United States (or both) has been in place. While prices of beef imports have not been affected by this ban, import prices of both pork and poultry increased due to an increase in demand for these products. Pork dummy is equal to one for the period 1996:11-2000:3, and zero following March of 2000. Pork exports by South Korea to Japan ended in March of 2000 because of a reported outbreak of foot-and-mouth disease. While Japan has subsequently recognized that South Korea is again FMD free, an outbreak of classical swine fever in South Korea in October 2002 triggered a second ban on exports to Japan, before the FMD ban had expired. The Korean island province of Cheju may be cleared for exports to Japan in the last half of 2005. For the rest of South Korea, the possibility of exports to Japan is foreclosed until 1 year after the last vaccination against classical swine fever occurs. Price of pork imports from other countries increased in response to this ban, while prices of beef and poultry, interestingly, decreased. Similarly unexpected result is the decrease in price of imported pork due to bans on poultry imports from China and Thailand due to bird flu. These somewhat unexpected results may be partially explained with the fact that there were simultaneous bans on imports of these three meats in the last 5-6 years and the effect on consumer perception, consumption and in turn on the import prices of these three meats from remaining countries is highly ambiguous.

5. Summary and Conclusions

The effect of exchange rate pass-through on import prices is a question of significant interest to many nations and especially those with permanent trade deficit. Japan is traditional net importer of food products in general and meat products including beef, pork, and poultry in particular. Most of the Japanese meat imports come from a few countries thus making Japan potentially very sensitive to the swings in one or a few bilateral exchange rates. This was the motivation to estimate the exchange rate pass-through effect on meat import prices in Japan. Interestingly, results for different meats differ substantially. For instance, poultry import prices indicate almost complete exchange rate pass-through, while beef import prices indicate partial (relatively high) exchange rate pass-through. Import prices of pork, on the other hand, indicate zero exchange rate pass-through. In terms of competitiveness, these results suggest almost perfectly competitive markets among poultry importing firms, somewhat competitive markets among beef importing firms, and a high degree of market power among the pork importing firms.

One of the key contributions of this paper is the use of the meats imports weighted exchange rates in the analysis. The standard practice in previous agricultural trade studies related to either exchange rate pass-through or pricing to market was to use the aggregate trade weighted exchange rates usually provided by the Central Bank authorities or sources. Our approach is novel and is due to recommendations from Goldberg (2004) and Pollard and Coughlin (2006).

A few other variables such as prices of substitutes, change in foreign input costs, expenditures/income, and an array of trade policy proxies affect the Japanese meat import prices. While this study is clearly of interest to Japan given its full reliance on imports in its meat consumption, the results of the study are also useful to the firms exporting meat products to Japan since they help them incorporate the effect of exchange rate fluctuations into the reaction of Japanese importing firms. Finally, similar study is likely be of interest to countries such as Australia, Canada, or the United States which are net exporters of food products considering their relatively more open economies today relative to two or three decades ago. This seems to be a promising area for future research.

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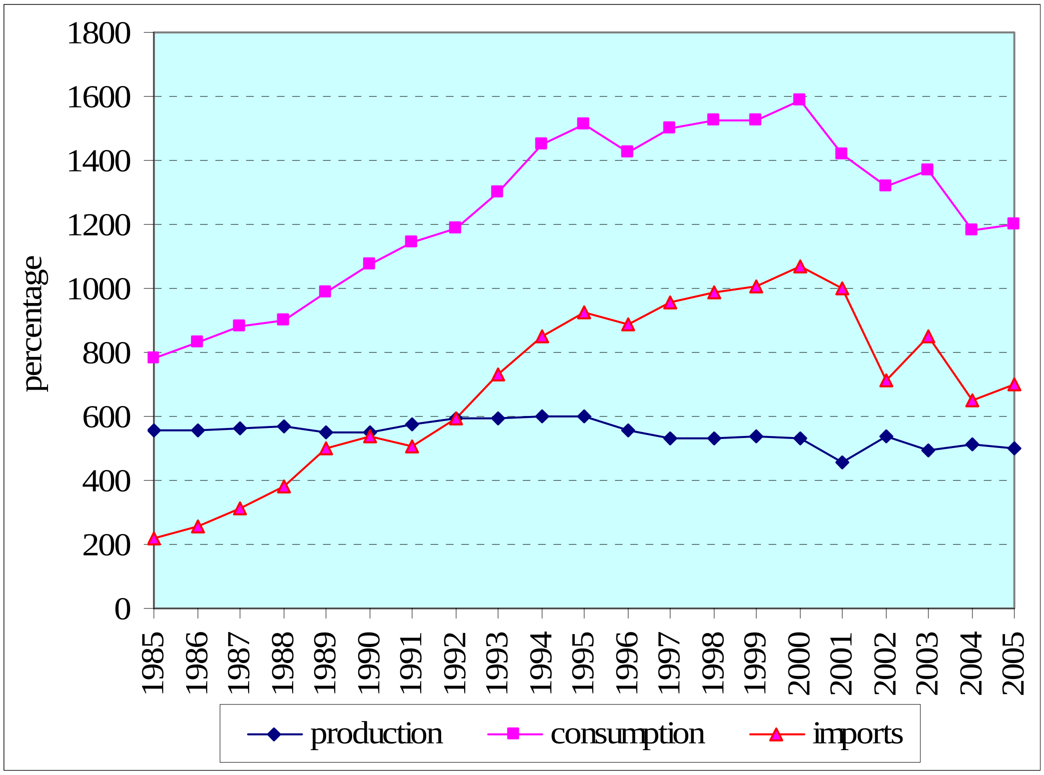

Figure 1- Japanese Beef Production, Consumption, and Imports in 1985 – 2005
Source: U.S. Department of Agriculture, PS&D database.

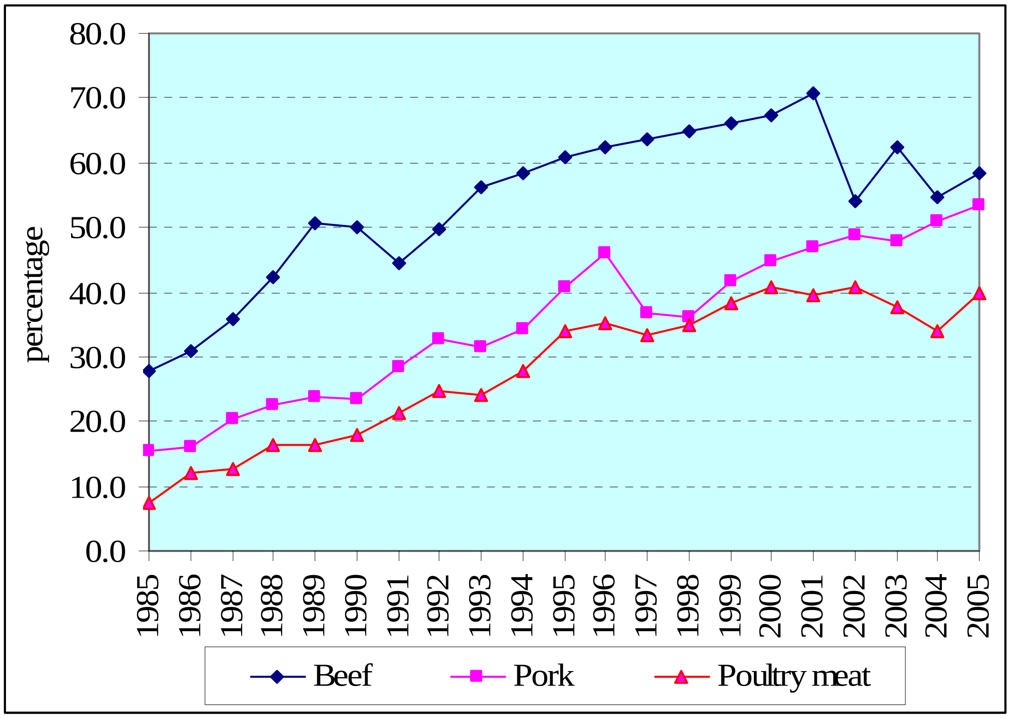

Figure 2 – Share of Imported Meat in Total Meat Consumption in Japan
Source: U.S. Department of Agriculture, PS&D database.

Table 1 – Production, Consumption, and Imports of Beef, Pork, and Poultry Meat in Japan in 1985-2005

	Beef			Pork			Poultry Meat		
	prod	cons	imports	prod	cons	imports	prod	cons	imports
1985	555	780	216	1531	1750	272	1,270	1,345	100
1986	559	830	256	1552	1860	297	1,297	1,433	174
1987	565	880	315	1581	1982	401	1,340	1,535	195
1988	570	900	380	1578	2040	461	1,346	1,607	261
1989	548	986	498	1594	2057	491	1,355	1,656	271
1990	549	1,073	537	1555	2069	488	1,332	1,637	291
1991	574	1,142	508	1483	2083	590	1,301	1,630	347
1992	592	1,190	591	1432	2087	684	1,252	1,637	406
1993	593	1,302	731	1433	2074	653	1,252	1,622	390
1994	602	1,451	847	1390	2120	728	1,145	1,601	444
1995	601	1,513	922	1322	2133	869	1,171	1,723	585
1996	555	1,428	889	1266	2196	1010	1,130	1,736	613
1997	530	1,497	954	1283	2134	786	1,124	1,718	575
1998	530	1,525	989	1285	2146	777	1,097	1,696	590
1999	537	1,523	1,007	1277	2212	919	1,078	1,742	667
2000	530	1,585	1,067	1269	2228	995	1,091	1,772	721
2001	458	1,419	1,002	1245	2268	1068	1,074	1,797	710
2002	537	1,319	712	1236	2377	1162	1,107	1,830	744
2003	496	1,366	851	1260	2373	1133	1,127	1,841	695
2004	514	1,181	647	1272	2562	1302	1,124	1,713	582
2005	500	1,201	700	1245	2507	1339	1,166	1,880	748
Mean (1985-2005)	547.4	1242.4	696.1	1385.2	2155.1	782.1	1199.0	1673.9	481.4
	(36.6)	(254.3)	(264.5)	(135.1)	(192.2)	(318.9)	(100.2)	(129.9)	(208.9)
Mean (1996-2005)	518.7	1404.4	881.8	1263.8	2300.3	1049.1	1111.8	1772.5	664.5
	(27.8)	(137.7)	(148.8)	(16.9)	(148.8)	(192.3)	(28.0)	(62.2)	(68.7)

Note: numbers in parentheses are standard deviations.
Source: U.S. Department of Agriculture PS&D online database.

Table 2 – Parameter Estimation Results for the Beef, Pork, and Poultry Meat Equations

Variables (Parameter)	Beef	Pork	Poultry Meat
Intercept (β_0)	-1.202 (2.525)	-4.829 (4.902)	-9.294*** (1.095)
Exchange rate (β_1)	0.504*** (0.084)	0.129 (0.113)	0.943*** (0.097)
Home substitute (β_2)	0.499 (0.297)*	0.068 (0.655)	1.196*** (0.133)
Foreign Input Cost ($\beta_{3)}$	0.004 (0.113)	0.369*** (0.059)	0.022 (0.107)
Expenditure (β_4)	0.086 (0.066)	1.135***(0.236)	0.014 (0.053)
Monthly Dummy 1 (λ_1)	-0.059 (0.043)	0.111 **(0.043)	-0.020 (0.038)
Monthly Dummy 2 (λ_2)	0.014 (0.046)	0.142*** (0.045)	0.011 (0.040)
Monthly Dummy 3 (λ_3)	0.025 (0.042)	0.101** (0.040)	0.087** (0.041)
Monthly Dummy 4 (λ_4)	0.011 (0.043)	0.061 (0.048)	0.125*** (0.043)
Monthly Dummy 5 (λ_5)	0.022 (0.040)	0.001 (0.043)	0.140***(0.043)
Monthly Dummy 6 (λ_6)	0.017 (0.043)	0.016 (0.046)	0.176*** (0.045)
Monthly Dummy 7 (λ_7)	-0.022 (0.041)	0.013 (0.047)	0.198*** (0.047)
Monthly Dummy 8 (λ_8)	-0.032 (0.038)	0.076* (0.044)	0.213*** (0.047)
Monthly Dummy 9 (λ_9)	-0.007 (0.044)	0.098** (0.043)	0.221***(0.044)
Monthly Dummy 10(λ_{10})	0.0206 (0.046)	0.034 (0.038)	0.138*** (0.040)
Monthly Dummy 11(λ_{11})	-0.005 (0.044)	0.071* (0.038)	0.072* (0.038)
Dummy for Beef (λ_{12})	-0.038 (0.032)	-0.058 *(0.033)	-0.177*** (0.035)
Dummy for Pork (λ_{13})	0.069*** (0.065)	-0.036*(0.021)	0.056* (0.030)
Dummy for Poultry (λ_{14})	0.017 (0.014)	0.192*** (0.045)	-0.046 (0.043)
Adjusted R^2	0.541	0.454	0.782
White Statistics	0.406	0.465	0.440
Shapiro-Wilk W	0.97	0.96	0.98
Mardia Skewness	17.02 with a corresponding p-value of 0.074		
Mardia Kurtosis	-1.12 with a corresponding p-value of 0.264		
Henze-Zirkler T	1.51 with a corresponding p-value of 0.131		

Note: ***, **, and * represent significance level of 1%, 5%, and 10%, respectively.

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Standard errors are in parentheses beside coefficient estimates. While Shapiro-Wilk W is the normality test for specific equation, Mardia's skewness and kurtosis as well as Henze-Zirkler T are the system testing for normality.