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The demand for meat in Japan: disaggregation and its effect upon estimated demand

Bruce Lambert

To the Graduate Council:

I am submitting herewith a thesis written by Bruce Lambert entitled "The demand for meat in Japan: disaggregation and its effect upon estimated demand." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Kim Jensen, Major Professor

We have read this thesis and recommend its acceptance:

Greg Pompelli, Don Clark

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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THE DEMAND FOR MEAT IN JAPAN:
DISAGGREGATION AND ITS EFFECT UPON ESTIMATED DEMAND

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Bruce Lambert

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ABSTRACT

This study examines the effects of different model specifications upon estimates of Japanese meat demand. Two static Almost Ideal Demand Systems (AIDS) are estimated using two different levels of disaggregation in Japanese meat consumption. The demand relationships among various meat groups are estimated and compared between a model based on origin and a model based on quality differences.

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CHAPTER I

BACKGROUND

Japan has recently signed separate trade agreements with both the United States and Australia, increasing the quotas on beef imports. The Beef Market Access Agreement (BMAA) gradually phases increased quota levels into a system of tariffs. In 1993, the system of tariffs becomes subject to any tariff reductions agreed upon in the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). This liberalization of the Japanese beef sector could lead to significant changes in both trade flow and consumption patterns by 1993. However, changing patterns in the demand for meats in Japan, and the divergence of reported demand elasticities, make the effects of liberalization upon demand for beef and other meats uncertain.

Japan has experienced an increased demand for imported beef for several reasons. The first is the growing level of income. This rising income has increased domestic demand for beef, which is viewed as a luxury item. The various estimates of income elasticities reported by Coyle (1983a) range from a low of 0.5 in 1970 to an upper estimate of 1.89 in 1978. The growth of income led to increased demand for all grades of meat, but especially the higher grades of meat, Wagyu Grades Supreme and Superior (see Table I.1 for a definition of the various grades of beef in Japan). Changes in tastes and preferences, including changing cooking habits and increasing consumption of prepared and away-from-home foods, have helped promote import expansion with increased acceptance of grain and grassfed imports (Longworth).

Table I.1. Beef Carcass Grades in Japan[a]

Japanese Grade	Official Statistics	Other[b]
Tokusen	Supreme	Super Grade
Gokukyu	Superior	Choice
Jyo	Excellent	First Grade
Chu	Medium	Second Grade
Nami	Common	Third Grade
Togai	Utility	Under Third Grade

[a] Grades are listed consecutively from top grade to bottom grade
[b] This refers to common distinction other than official statistics.

Source: Simpson, James R., et al., (1985) Technological Changes in Japan's Beef Industry. Westview Press, Boulder, Colorado.

Traditionally, meat consumption was a small percentage of total protein intake, but after the early 1960's, expansion of pork and poultry consumption increased per capita meat consumption. The growth in domestic beef production has been not as evident as in the other livestock industries, but production has persistently increased, largely from dairy steers and heifers. This slow rate of growth has failed to satisfy domestic demand, increasing the demand for beef imports.

The Japanese market represents a large segment of the meat exports of three nations, the United States, Australia, and New Zealand (Table I.2). Japan is the largest export market for US produced beef, and the second largest market for Australian and New Zealand beef, following the United States market. Beef imports from these countries represent the majority of the beef imported into Japan.

Japanese beef imports must arrive from disease free areas, limiting the countries which can export beef to Japan (Simpson). This results in a separate trade block, insulating disease-free countries from changes in world meat prices. Import restrictions are not imposed upon selected nations, but are labelled global, open to all importers which meet the necessary health restrictions. As such, liberalization is anticipated to bring additional levels of beef imports from the United States, Australia, and New Zealand, and thus greater returns for domestic producers in these countries.

This anticipated growth in imports will influence Japanese domestic meat consumption. Researchers agree that imports must be increased to satisfy domestic demand (all Wahl, et al., Simpson, Anderson, Hayami, Mori and Gorman), but the disagreement lies within the actual demand changes that may result from liberalization. Williams examined

Table I.2. Sources of Japan's Beef Imports, 1960-1987, by Volume

	Australia		United States		New Zealand		Others[a]		Total	
Year	mt	%	mt	%	mt	%	mt	%	mt	%
1960	2,821	48.7	47	0.8	2,916	50.3	4	0.0	5,788	100.0
1965	7,774	71.9	7	0.0	2,569	23.8	463	4.2	10,813	100.0
1970	20,123	86.6	362	1.5	2,511	10.8	231	0.9	23,227	100.0
1975	37,109	82.6	3,545	7.9	3,512	7.8	757	1.7	44,923	100.0
1976	77,025	81.7	11,864	12.6	4,639	4.9	705	0.8	94,233	100.0
1977	72,055	85.2	7,330	8.7	3,903	4.6	1,259	1.5	84,547	100.0
1978	78,173	77.5	13,026	12.9	7,800	7.7	1,865	1.9	100,864	100.0
1979	101,268	76.8	24,672	18.7	3,510	2.7	2,342	1.8	131,792	100.0
1980	93,614	75.5	26,674	19.1	3,991	3.2	2,673	2.2	123,952	100.0
1981	87,071	70.4	27,543	22.3	6,148	5.0	2,884	2.3	123,646	100.0
1982	86,099	70.2	32,079	26.1	3,645	3.0	871	0.7	122,694	100.0
1983	91,043	66.2	37,728	27.4	7,734	5.6	1,037	0.8	137,542	100.0
1984	91,962	63.4	41,640	28.7	7,580	5.2	3,902	2.7	145,084	100.0
1985	93,129	62.0	45,938	30.6	6,965	4.6	4,175	2.8	150,207	100.0
1986	105,266	59.2	62,137	34.9	6,038	3.4	4,507	2.5	177,948	100.0
1987	121,127	55.0	85,292	38.8	7,862	3.6	5,752	2.6	220,032	100.0

[a] Includes Canada, Mexico, Ireland, but these countries have not consistently been engaged in the Japanese market.

Source: MAFF, Livestock Industry Bureau. The Meat Statistics in Japan for 1960-1986. United Nations Commodity Trade Statistics for 1987.

liberalization effects using data for Wagyu, domestic dairy beef, imported beef, pork, and poultry. Mori and Gorman questioned any disaggregation that equates imported beef with domestic Wagyu or higher dairy grades, implying that this would result in overestimation of the value of imported beef in Japan. Other researchers have questioned the relationship of imported processing meats to imports and domestic beef (Fraser, Lin, et al.). Processing meat imports (imported edible offal, imported horsemeat and lamb and mutton), have been steadily increasing, and any changes in domestic beef markets will likely effect the continued growth of processed beef consumption.

Researchers have suggested that disaggregation would be useful in the evaluation of any expansion in the Japanese markets (Mori and Gorman, and Alston, et al.). Alston, et al., suggest that the absolute increase or decline in the expanded market depends upon the substitutability in consumption between the meat from the different exporting countries. The majority of liberalization studies have concluded that imports are necessary to maintain domestic prices for both consumers and producers, due to the lack of growth in the domestic beef sector and strengthening domestic beef demand (Coyle 1983a, Simpson, et al., Longworth).

Coyle (1983b) used beef as an aggregate, included only domestic dairy beef in his study of trade liberalization. Most studies have disaggregated beef according to type, (Wagyu and/or dairy) and imported beef (Williams, all Wahl, et al., Lin, et al., Hayami, Anderson).

When Hayes, et al., examined the Japanese beef market, they were primarily concerned with testing for separability between groups according to origin. While such an approach is potentially useful in examining the effects of trade liberalization, the use of whole cattle or hogs as consumption units may not provide the appropriate level of disaggregation in demand analysis. This failure to examine parts or differences in quality type, as viewed by the consumer, may lead to bias in estimating consumption responses.

Eales and Unnevehr argue that structural change could occur between different cuts of a particular aggregated meat source. The example they used was the structural change in consumption from whole chickens to chicken parts by American consumers. It can be argued that structural change could occur between disaggregated products that would not be observed by studying aggregated levels only.

Changes in consumption may not be the result of income and price effects, but rather of changes in the mix of products consumed (Eales and Unnevehr). The use of such a distinction in product form would allow for changes in cooking and consumption patterns rather than retail cuts.

Three basic methods of disaggregation have been used in past studies. The first method disaggregates beef according to whether the beef was grassfed or grainfed (Badinger and Bobst). This approach may be useful in determining the differences in the Japanese market if the differences in price and quantity reflected only whether beef was grainfed or grassfed. However, the majority of beef produced in Japan is grainfed, as are some imports, thus, this approach would only distinguish between culled domestic cattle and grassfed imports, and all other beef.

The second approach is to disaggregate meat according to retail cuts. This approach would be useful in examining structural change in consumption of the various commodities (Eales and Unnevehr), but will not be used in this study due to a lack of data. This necessitates the use of a third approach developed by Ospina and Shumway.

The Ospina-Shumway model disaggregates the Japanese market into both class and quantity components. Beef is disaggregated according to the carcass grade and type, differentiated by inputs and prices. The advantage of the Ospina-Shumway model is that beef grade is the driving force in cattle production in Japan, as domestic producers tend to overfeed, attempting to achieve higher grades and higher returns. Further, disaggregation according to grade and quality can serve as proxies for differences in Japanese cooking styles.

The effects of liberalization upon meats, other than beef, have also been analyzed. Coyle (1983b) concluded that domestic consumption of beef would double from 1980 to 1990 and would be strengthened at the expense of pork and poultry. Hayami concludes that liberalization would affect pork and poultry consumption because of reduced beef prices, but the high price of fish, the main dietary protein in the Japanese diet, would help to some extent in stabilizing pork and poultry prices near current levels. Mori and Gorman (1985) also discussed the failure of researchers to include edible offal imports in consideration of the Japanese beef liberalization, but provided no estimates as to the effect of liberalization on edible offal.

Sapp and Williams, recognizing that imports will increase, concluded that liberalization would not greatly alter the domestic consumption pattern. The actual levels of consumption will increase for beef, but the reduction in pork, poultry, and fish will be small. The larger own price elasticity of beef implies that reduced protection will likely result in increased per capita beef consumption.

PROBLEM STATEMENT

A primary concern facing research in the Japanese market is the failure to clearly approach the Japanese demand without importing Western bias. This could either by the result of insufficient data or that the Japanese market is not very clearly understood (Gorman and Mori) in terms of the relationships that exist between different grades of meat as well as meat substitutes. Hence, most studies fail to address the entire sector that import liberalization would affect. The aggregation of meat in most studies as a single homogeneous commodity fails to address the differences in demand for various grades of beef. This failure to identify Japanese tastes could produce biased results in attempting to define and predict Japanese meat demand.

The Japanese market cannot accurately be modeled when "Western cultural perceptions" are imposed on the model to obtain estimates of meat demand. For example, fish is the single largest source of animal protein in the Japanese diet. In contrast, Americans consume higher levels of red meats than the Japanese. Failure to estimate the entire meat sector could lead to misspecification of demand.

Several researchers (Lin, et al., and Hayes, et al.) have evaluated the Japanese market by disaggregating beef by origin (Wagyu, dairy, and imports). This method of disaggregation assumes that Wagyu, dairy, and imported beef are weakly separable. Given the importance of other protein sources in the Japanese diet, and the variation of quality between Wagyu, dairy, and imported beef, this method of disaggregation may not be appropriate.

OBJECTIVES AND METHODOLOGY

The general objective of this paper is to examine the effects of different levels of disaggregation upon estimates of Japanese meat demand, with emphasis upon the demand for beef. The specific objectives are to:

1. Estimate demand systems including sectors that are substitutes of beef, primarily pork, poultry, and fish, but also imported horsemeat and sheepmeat,
2. Determine whether edible offal is a substitute for domestic beef and/or imported beef,
3. Determine substitutability of imported meats between the different exporting countries as well as with domestic grades,
4. Determine whether benefits occur from using a disaggregated versus an aggregated model of the Japanese Beef Sector explaining the Japanese meat demand.

This study will estimate Japanese beef demand using disaggregation of beef into Wagyu, dairy, and imports as a basis of comparison for other methods of disaggregation. The model used in this study incorporates data disaggregated by perceived quality differences into a demand system in an attempt to identify the nature of the Japanese domestic market. Attention will be given to the various meats that are consumed in Japan, disaggregated by quality groups, in hopes of arriving at a better understanding of Japanese demand for meat products, including beef.

Final demand for any livestock product is not for the wholesale carcass, but for the price of specific cuts and forms. Data for retail prices of specific cuts are unavailable. However, since different levels of marbling are associated with different cooking methods, beef can be disaggregated according to grade and source, which serves as a proxy for cooking type rather than retail cut.

The procedures used in this study is to develop, econometrically estimate, and compare models of demand, with different levels of disaggregation. The various models will be attempts to compare demand systems that have been estimated in past studies with those that perhaps more fully capture Japanese meat demand. The model and its empirical estimations will be discussed in more detail in later chapters.

Time series data will be used to estimate consumption from 1974 to 1984. The year 1974 has been selected as the base year, primarily because Japan closed its markets to beef imports in 1974 and part of 1975 in response to unacceptably high levels of imports and high prices of imported feed grains which drove many producers out of business. The year 1984 is the last year that carcass grade prices and slaughter percentages were available.

CHAPTER II

THE JAPANESE MEAT SECTOR

A variety of different factors have increased demand for all meats, as well as restricted the success of domestic production to satisfy the Japanese consumer. These factors have led to a complex domestic beef industry, which must be discussed before beef demand can be successfully analyzed. Therefore, the primary influences on and the characteristics of, the Japanese meat sector are summarized in this chapter.

CONSUMPTION

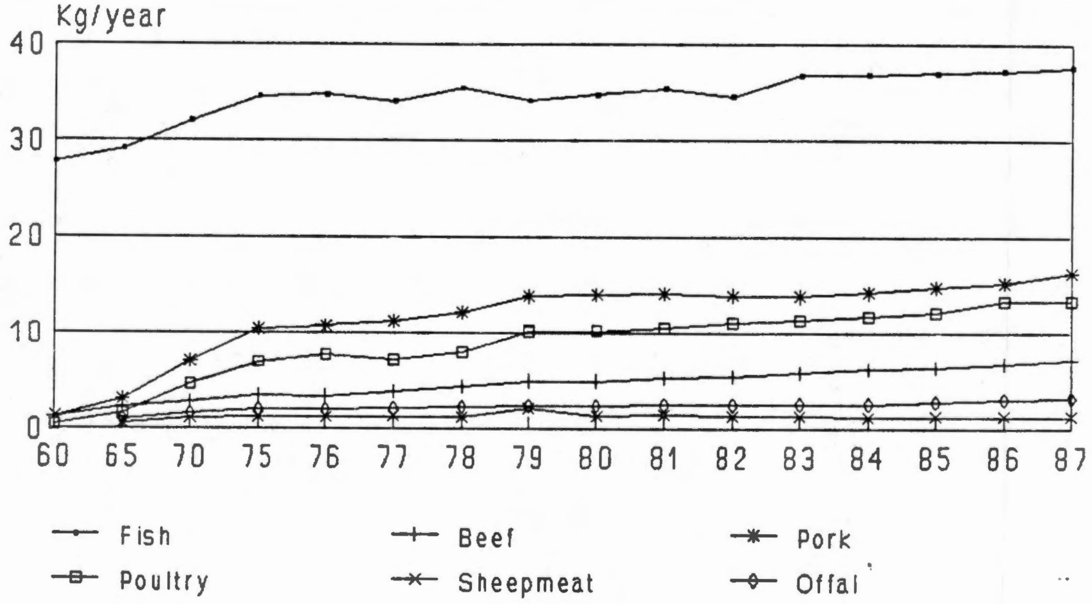
The traditional Japanese diet primarily depended upon both vegetables (rice and soybeans) and fish as sources of protein. The consumption of red meats was forbidden, due to the Buddhist teachings of avoiding blood and the touching of dead bodies (Longworth). The available domestic cattle was thus used for draft purposes only. However, the Meiji Restoration, which began to "open up" Japan to the West, removed the ban on beef consumption ~~beef~~ in 1872.

Until the 1950's, beef production consisted mainly of culled draft animals, which were fed high concentrate rations prior to slaughtering. During the 1950's, the rapid growth of domestic income increased demand for meat products, which were viewed to some extent as a sign of greater affluence. The per capita consumption of beef, pork, poultry, while at low levels when compared to western standards, were all consumed equally (Figure II.1). The growth in per capita consumption of both pork and poultry increased in part due to the continuing growth in Japanese disposable income, but also in the growth of modern containment practices that increased production, and thus market availability.

The relative price of both pork and poultry fell over the period, while the relative price of beef actually rose over the same period (Williams). Increases in pork and poultry consumption when compared with beef do not necessarily reflect Japanese consumer preferences for these meats to beef, but may reflect the fact that beef has not experienced the same success in expanded production as pork and poultry (Williams). The higher priced beef thus encouraged more consumption of the lower price pork and poultry.

Other meats that are consumed in Japan consist of horsemeat, sheepmeat, and fish. Horsemeat and sheepmeat are largely used in minced meats or "pressed hams", but in some areas, raw horsemeat is considered a delicacy (Longworth). Fish consumption in Japan has remained steady over the same period, but the Japanese now consume more higher quality fish, such as tuna, and less lower quality fish, such as sardines (Coyle 1983a). The growth of red meat consumption has had little impact upon consumption of fish meat (Longworth).

The Japanese consumer tends to prefer heavily marbled beef, and will pay a premium for the additional marbling (Mori, Gorman, and Faminow). Excessive marbling is viewed as resulting in a better quality steak. The heavy emphasis upon marbling is important in the cooking of such traditional dishes as sukiyaki and shabu-shabu, which involve



Source: MCA, Japan Statistical Yearbook, various issues, OECD, Meat Balances in OECD Countries, various issues

Figure II.1. Japanese Per Capita Consumption of Meat Products, 1960-1987

boiling the meat. The increased exposure to both Western and other cooking styles has influenced Japanese changing cooking methods to including barbecue, curry dishes, and ground beef (moving from the most to least marbling) (Miyazaki).

Most researchers (Mori and Groman, Miyazaki, and Williams) recognize the importance of the Japanese market for future growth in beef demands. Williams stated that beef demand is so strong that unless the quota is set above the level of imports the market would determine, then the growth in beef consumption would push the level of imports quickly against the quota level again. Miyazaki however stated the Japanese market may be saturated with lower quality meats, but expected a growth in demand for higher quality meats.

BEEF PRODUCTION

Wagyu beef only accounts for roughly one-third of domestic beef production. Beef from dairy steers, fattened heifers, and culled cows accounts for the remaining two-thirds. The growth in dairy beef largely is the result of the high price of Wagyu, and the lack of expansion in production of Wagyu beef. The production of dairy beef, depends only partially upon the price of beef, since the sale of dairy beef only accounts for ten to twenty percent of a dairy producer's income (Coyle 1983a).

There are distinct differences between dairy and Wagyu beef (Figure II.2 and Figure II.3). Wagyu beef is sold at a higher price than comparable grade levels of dairy beef, and only Wagyu is capable of

Cooking Type	Price $/LB	Supreme	Superior	Excellent	Medium	Common	Utility
		1.3%	4.0%	18.3%	44.6%	29.2%	5.6%
Sukiyaki (High Quality)	19.1 - 136.4		FS,FH[a]				
Sukiyaki (Med Quality) and Steak	6.8 - 24.5			FS,FH			
Barbecue	9.5 - 13.6				FS,FH		
Curry	5.5 - 9.5					FH, FS,CCW	
Hamburger	3.3 - 7.6						CCW

Grade of Carcass (column group: Supreme to Utility)

[a] Conditions: Fattened (F), Culled (C)
Sex: Steer (S), Heifer (H), Cow (CW)

Source: Miyazaki, Akara (1987). "Production and Consumption of Beef in Japan".

Figure II.2. Price and Distribution of Wagyu Beef According to Grade and Consumption Type, 1987.

Cooking Type	Price $/LB	Grade of Carcass Supreme	Superior	Excellent	Medium	Common	Utility
		0.0%	0.1%	1.4%	35.4%	44.0%	19.1%
Sukiyaki (High Quality)	19.1 - 136.4						
Sukiyaki (Med Quality) and Steak	6.8 - 24.5		FS [a]				
Barbecue	9.5 - 13.6				FS,FH		
Curry	5.5 - 9.5					FH, FS,CCW	
Hamburger	3.3 - 7.6						CCW

[a] Conditions: Fattened (F), Culled (C)
Sex: Steer (S), Heifer (H), Cow (CW)

Source: Miyazaki, Akara (1987). "Production and Consumption of Beef in Japan".

Figure II.3. Price and Distribution of Dairy Beef According to Grade and Consumption Type, 1987.

producing "super" or Kobe beef. The price differences between grades of either Wagyu or dairy beef reflect the above mentioned emphasis on an older, mature carcass, as these carcasses tend to receive the higher grades.

Wagyu beef produces all grades, whereas only dairy beef heifers can produce the Superior grade and dairy steers can only reach the Excellent grade. No live cattle grades exist, so all grades are based upon slaughtered carcasses. However, different meat markets grade the carcass at different points along the rib cage, reflecting traditional differences in meat consumption in each region. The Tokyo and Kyoto markets grade the carcass at the fifth/sixth rib section, and the Osaka market grades carcasses between the seventh and eight ribs. The rib section location of the grade is important in measuring marbling. The further down the rib section the carcass is graded, there is less emphasis upon the amount of marbling, and more emphasis upon the size of the ribeye (Simpson, et al.). In comparison, the United States grades carcasses on the twelfth and thirteenth rib location.

Domestic beef production could continue to expand, as was the case in the sixties and seventies, but expansion is limited by several factors. The first factor is the price of milk. Dairy beef accounts for the majority of domestic production, but the consumption of dairy products has leveled off, leading to surplus production. The liquidation of the dairy herd in response to such a policy change would increase domestic beef production in the short run, but led to reduced production in the long run. The second factor is the growth of dairy fatteners who raise dairy animals for meat production only.

Liberalization could greatly reduce the success of these producers. Lastly, the lack of available land, and the high price of feeder calves, has likewise limited successful expansion of domestic beef. This leads to the continued reliance on imported beef.

IMPORTS OF BEEF

The Japanese market is very segmented, and as such, beef is not a homogeneous product (Longworth). There is some disagreement, however, about the relative value of imported beef in the Japanese markets. Grainfed beef, largely produced in the US, is sold in the Japanese markets for both retail and institutional use. Longworth hypothesizes that grainfed beef is comparable to average quality (Medium Grade) Wagyu beef, whereas, Gorman and Mori argue that grainfed imports are equivalent of dairy beef, Medium Grade. Grassfed beef is primarily used in institutional or processed meats, and is comparable to Common Grade domestic dairy beef (Gorman and Mori).

By comparing various ad valorem tariff equivalencies, there is some disaggregment as to the substitutibiliyt of imported beef for domestic beef. Wahl, Williams, and Hayes have calculated that the quota is the equivalent of a 240 percent ad valorem tariff in 1987, and will fall to sixty percent in 1990. The USDA calculated that the ad valorem tariff equivalent was only ninety-six percent. The differences may by biased due to the unique characteristics of the Japanese market and the substitutability of imported beef for domestic beef used in calculating tariff equivalency. Figure II.4 illustrates the various grades and uses

Cooking Type	Price $/LB	Grade of Carcass					
		Supreme	Superior	Excellent	Medium	Common	Utility
		0.0%	0.0%	0.0%	20.1%	79.9%	0.0%
Sukiyaki (High Quality)	19.1 - 136.4						
Sukiyaki (Med Quality and Steak)	6.8 - 24.5				GN		
Barbecue	9.5 - 13.6				GN		
Curry	5.5 - 9.5					GS	
Hamburger	3.3 - 7.6						GS

[a] Conditions: Grainfed (GN), Grassfed (GS)

Source: Miyazaki, Akara (1987). "Production and Consumption of Beef in Japan".

Figure II.4. Price and Distribution of Imported Beef According to Grade and Consumption Type, 1987.

of imported beef based upon whether the carcass was grassfed or grainfed.

Prices of imported beef from different regions may reflect domestic conditions, such as changes in domestic supply and demand, exchange rates, and/or changes in carcasses traded (Lin, et al.). The relative price of US beef, when compared to the price of Australian and New Zealand beef exports, has decreased for two reasons. First, the US has shifted to producing less marbled carcasses, which are not as readily accepted in the Japanese market (Longwoth). Second, the falling Dollar/Yen exchange rate has lowered the price of US beef abroad. However, this does not mean that price competition by the United States would increase market share. Lin, et al., calculated that lowering the price of US beef would produce marginal increases in US market share, while Hayes argues that price decreases may result in questions about the quality of US beef exports.

Trade, however, has shifted towards imports of grainfed beef, from seven percent of total imports in 1977 to thirty-one percent in 1986, with the corresponding loss due to reduced grassfed beef imports (Fraser). Due to the different types of domestic beef production, dairy beef is more affected by imports than Wagyu, at least in short run, because the former is closer to imported beef than the latter in terms of quality. Nonetheless, it does not mean that the dairy sector is less resilient than the Wagyu sector in medium or the long run, because production structure and costs are different between the two sectors (OECD, 1987).

The increase in the United State's share of the Japanese beef market since 1975 is likely in response to four major changes. The first is the decline in relative price of US beef in comparison to Australia, New Zealand, and Japanese beef (Lin, et al.). Secondly, there is a reported preference for US beef by Japanese consumers, who prefer grainfed beef over grassfed beef (Longworth). Next, the USDA and US beef producers have actively encouraged the consumption of US produced beef in Japan, including the opening of the Meat Export Federation Office in Tokyo. Lastly, the growth in United States market share is due to political manipulation of the quota system by the Japanese to appease the United States government (Sato and Curran, Anderson, Lin, et al.).

Most past studies have failed to include edible offal as a part of beef imports (Fraser, Coyle and Dyck). The primary reason for this failure is that the Japanese government does not record edible offal as beef, but rather as a separate category. Imported edible offal is mainly diaphragm meat, and consists of both the thick skirt (hanging tender) and the thin skirt (outside skirt). Grainfed diaphragm meat is processed and sold as "American" or "family" steaks and retail at the lower end of the market. Grainfed edible offal diverts demand away from lower quality grassfed imports. Grassfed diaphragm meat is used for making minced meat products.

Since 1975, edible offal imports, largely from the United States, have increased. Edible offal is not restricted by quotas, but is subject to a fifteen percent tariff. The addition of edible offal increases the market share of the United States.

Fraser states that the rapid expansion of unrestricted US-Japanese trade in edible offal has affected the Japanese market in three ways. First, edible offal reduces the Japanese potential to control beef imports, due to the lower price and basically unlimited access of edible offal. Second, U.S. edible offal reduces the offal trade of other supplying areas. Last, it depresses demand for Australian and New Zealand grassfed beef imports.

Restrictions on beef imports may influence imports of sheepmeat and horsemeat. Both sheepmeat and horsemeat do not compete with the higher quality beef, but do compete with edible offal imports, lower quality pork, sheepmeat, and slaughter calf supply.

BEEF POLICY

The basic position of the Japanese Government is to first encourage domestic production, and if production can not be expanded, to protect domestic producers by stabilizing the price of imports (OECD). The goal of self sufficiency is thus very important to the Japanese government and growing imports potentially pose a threat to both agricultural producers and national food security. Because Japan imports roughly half of its food needs, the threat of increased imports has caused the erection of trade barriers to limit dependency and to encourage domestic production. The lack of domestic beef expansion resulted in the development of beef policy to maintain domestic production in response to the growth in domestic demand for imported beef.

In order to encourage domestic production, the Japanese government has implemented a variety of programs. These programs consist of the maintenance of feed grain stocks and pasture subsidization, as well as feeder calf price support. However, the Livestock Industries Promotion Corporation (LIPC) has the greatest impact on the maintenance of domestic beef production through the use of the import quota system to control domestic prices.

The role of the LIPC is to stabilize prices of major livestock products (beef and dairy products), and to provide assistance to producers for the development of the livestock industry. The LIPC has been successful in maintaining domestic beef prices while reducing domestic beef price variability, especially when compared to pork and poultry (Williams).

The first role of the LIPC is to determine the price support levels for beef, then to maintain domestic prices through the use of import quotas. The current system of price stabilization was initiated largely in response to the 1973 crisis. When the market price exceeds the stabilization price, the LIPC sells stocks, irrespective of whether these stocks were of domestic or foreign origin. When market price falls below the stabilization price, the LIPC purchases at the base price in wholesale markets or offers financial assistance to authorized stock holding programs, planned and conducted by agricultural cooperatives. In reality, neither scenario has been used due to the effectiveness of the quota and other measures such as feed price stabilization policies, and feeder calf price support systems (OECD, 1987).

The success of the price stabilization system rests largely upon the import quota system. The LIPC controls the majority of beef imports (roughly eighty percent in the period studied). Beef imports are also subject to a twenty-five percent ad valorem tariff. This implies that imported beef is a close substitute for domestic beef. The nature of the Japanese market implies that some level of substitution exists, but due to differences, perceived or real, the actual effectiveness of the price stabilization could be questioned.

The sale of imported beef in domestic markets has enabled the LIPC to capture economic rents, since imported beef is relatively inexpensive when compared to the price of domestically produced Japanese beef. These excess profits have been traditionally used to promote domestic livestock interests, primarily beef.

There is some disagreement about the differences in the price of imported beef and the price of domestically produced beef. The price difference between imported beef and domestic beef may be the result of difference in product form, rather than the difference in tariff or quota restrictions (OECD, 1987). The OECD argues that, to a limited extent, the price differences between domestically produced carcasses and imported carcasses may reflect a difference in the quality of the carcass, and estimated that the quality of the imported beef carcass was only sixty percent of the domestically produced carcass. The differences in price thus may not reflect trade distortion, but rather product differentiation. Mori and Gorman (1985) support this argument by claiming that by producing heavier carcasses in the United States for the Japanese market would increase US market share without increasing liberalization.

The OECD further argues that there is little price discrimination due to the fact that the quantity of imported beef sold in domestic markets is large in comparison to the quantity of domestic beef, and that imported beef is sold in a competitive nature. The average sale price of LIPC imported beef is thus realized in a competitive market. The OECD extends this proposition by stating that the level of quality differences between the two carcasses may not change in light of liberalization. The absence of the present price support system will result in a drop in prices, but if the quality coefficient remains at sixty percent, then imported prices will also fall. If the associated fall in both prices maintains the quality coefficient, then the drop in prices could lead to overestimation of liberalization effects given that the Japanese market exhibits this trait over time (OECD, 1987).

Gorman and Mori discussed how imports are not sold in competitive markets due to the Livestock Industry Promotion Corporation (LIPC) and the structure of the domestic beef industry. They argue that the US is unable to identify its role in domestic Japanese markets due to the failure of the US to recognize the type of beef being produced in Japan. Such differences include varying standard cuts and carcass grades between Japan, the United States and Australia, and differences in product form (fresh, frozen, chilled).

PORK, POULTRY, AND FISH PRODUCTION

The growth of the pork and poultry industries is the result of modern confinement production techniques, which overcome the land constraint that limited beef expansion. Both pork and poultry production have been able to keep pace with increased domestic demand, but imports of both pork and poultry have beef increasing since the seventies.

Pork is produced by either farrow-to-finish or feeder pig operations. The major cost of farrow-to-finish is the price of feed, whereas for feeder pork operators, it is the cost of the feeder pigs. Increased efficiency in pork processing along with the growth in size of the pork inventory has resulted in a larger number of hogs slaughtered and an increase the profitability of pork production. As a result, hog slaughter increased rapidly from three million head in 1960 to over nineteen million head in 1983 (Williams). The rapid increase in production is larger than the relative increase in either litter size or inventories. The weight of pork carcasses increased from 52 kg/hd (115 lb/hd) in 1960, to 75 kg/hd (165 lb/hd) in 1983 (Williams).

Domestic pork production is protected by a variable levy. The variable levy is determined by the domestic price of imported pork, coupled with a tax equal to the difference of the border price to the predetermined import price. The United States and Canada have been consistent sources of Japanese pork imports, however, both Denmark and Taiwan have successfully increased exports into Japan since the early 1980's (Shagam).

Poultry production is largely an outgrowth of the broiler and egg markets that existed prior to World War II. Feed and chickens account for over eighty percent of the cost of production (feed is sixty-five to seventy percent of total costs). The live weight of broilers has increased from 1.88 kg (4.11 lb) to 2.14 kg (4.72 lb) for the period covering 1974 to 1978. Total slaughter of chickenmeat has increased more than the number of broilers slaughtered. Japan has little direct government involvement to support domestic poultry production. Except for sanitation restrictions, there are little or no border tariffs or quotas for most poultry products. The major importers into the Japanese market are the United States and Thailand, together accounting for eighty percent all poultry imports into Japan (Christensen and Witucki).

Fish is the main source of animal protein in the Japanese diet and is a vital part of the Japanese culture. The Japanese Islands have abundant natural fishery production, with many miles of coast, and the presence of strong ocean currents, the warm Kuroshio from the South and the cold Uyashio from the North. Japan also harvests many different breeds of fish in off-shore areas, such as the Northern Pacific and the East China Sea. The success of continued harvests in international waters has been restricted by the United Nations Conference on the Laws of the Sea (UNCLOS), limiting the catch taken in offshore areas. The Japanese industry has encouraged domestic fisheries and aquaculture to offset the decline in foreign fisheries. Japan is both the largest importer and exporter of fish in the world.

CHAPTER III

METHODOLOGY

The elasticity of demand for different types of meats in Japan has been researched by Lin, et al., Sapp and Williams, and Hayes, et al. These studies all examined demand, using data disaggregated by origin of meat product, rather than by final form or perceived quality differences.

Because beef in Japan is not a homogenous product, the level of disaggregation used in a model may limit the effectiveness of a model to represent Japanese demand. The procedure used in this study is the development, estimation, and comparison of several econometric models of Japanese meat demand with differing levels of disaggregation. A listing of the various models and the utility tree that each model is based upon is shown in Table III.1.

THE DISAGGREGATION OF THE MODEL

The first model takes into account differences in origin, and the effect that origin plays in dictating domestic consumption. The five sub-systems in the first model system are Wagyu, dairy beef, imported beef, fish, and other meats (utility tree A). This approach was rejected by Eales and Unnevehr, but will be included for purposes of

Table III.1 The Different Models and Level of Disaggregation

Utility Tree	Most Aggregated Stage	Disaggregated Model	Sub-Systems In the Model
A	ALL MEATS	Wagyu beef	Wagyu grade subsystem
		Dairy beef	Dairy grade subsystem
		Imported beef	Imported beef type subsystem
		Fish	Fish Subsystem
		Other meat	Other meat type subsystem
B	ALL MEATS	High Quality	High Quality by type and grade
		Table Quality	Table Quality by type and grade
		Lower Quality	Processing Quality by type and grade

comparison. This approach is extended to estimate the demand for various grades within each group.

Imports are assumed to be differentiated by country of origin and are separated into three major areas: beef imported from the United States, Australia, and New Zealand. Beef from other exporting regions and imported live animals are not estimated due to the limited role that each plays in Japan's meat sector (Longworth).

Fish products are differentiated into homogeneous quality items. Fish accounts for the largest source of animal protein consumed in Japan, but fish is not a homogeneous product. The models which disaggregate fish according to value found the prices of different meats to have different degrees of correlation with prices of different fish products (Hirasawa). Lin, et al., recognize the differences of disaggregating fish upon beef demand but did not disaggregate fish in their study. The three different groups of disaggregation are luxury, table, and lower fish, and are assumed to form a weakly separable group from beef and other meats.

Other meats are assumed to include imported horsemeat, lamb and mutton, edible offal, pork, and poultry. Imported edible offal represents lower quality imported beef that can be utilized in both the retail and processing sectors. Domestically produced edible offal is assumed to be incorporated in the wholesale price of domestic beef, and is therefore dropped in this study.

Both sheepmeat and horsemeat are imported into Japan, while domestic production of these two products is negligible. Another potential substitute for beef in the Japanese diet is pork. The supply of pork is not differentiated according to grade or origin (import or domestic), as all types of pork are assumed to be homogeneous. Domestic poultry meat is also not differentiated by type or grade, and is assumed to be identical to imported poultry meat.

The second model assumes that different quality groups of meats form weakly separable groups. These quality groups are based upon both economic and consumption patterns. There are three groups in this tree (Utility tree B), based upon whether the meat is high quality, table quality, or lower quality. Therefore, the disaggregation is according to quality groups, regardless of whether the meat is beef, poultry, fish, or pork.

Eales and Unnevehr only used two different groups, hamburger and table meats. However, due to the various cooking styles and the heterogeneous nature of beef consumption in Japan, this disaggregation level would still result in some level of bias in demand studies. The following meats are included in the high quality sub-group: Wagyu grades superior, supreme, and excellent, dairy superior grade, high quality fish. The second sub-group, table quality, consists of a domestic beef good (Wagyu medium and common, dairy excellent and medium), aggregated imported beef, imported edible offal, pork, and table quality fish. The last sub-group is lower quality, which is Wagyu utility, dairy common and utility, imported processing meats (horsemeat and lamb and mutton), chicken, and low quality fish.

THE ECONOMETRIC MODEL

This study employs a budgeting expenditure model to estimate demand elasticities. The procedure used is the Almost Ideal Demand System (AIDS). In the first stage, consumers are assumed to allocate their budget among all meats versus other goods. Consumers then allocate their meat expenditures among the various types of meats.

The AIDS model expresses $w_{i,t}$, the ith budget stage, as

(1) $$w_{i,t} = \alpha_i + \sum_j \tau_{i,j} \ln p_{j,t} + \beta_i \ln(X/P)_t, \quad \text{for all } i \ t=1..T$$

where $w_{i,t}$ is the expenditure share of the ith commodity in the period t, and $p_{j,t}$ are prices of the goods in the model, X is the total expenditure on all commodities in the system, and P is the price index such that

(2) $$\ln P_t = \alpha o + \sum_k \alpha_i \ln p_{k,t} + 1/2 \sum_k \sum_j \tau_{k,j}^* \ln p_{k,t} \ln p_{j,t} .$$

The index, P_t, may be replaced by an approximation in the form of the geometric index, P_t^*, to produce a linear approximation of the system. The index, P_t^*, is defined so

(3) $$\ln P_t^* = \sum_k \overline{w_k} \ln p_k,$$

where $\overline{w}_k$ is the mean of the expenditure share.

Therefore, the approximation of (1) is

(4) $$w_{i,t} = a_i^* + \sum_j \tau_{ij} \ln p_{j,t} + \beta_i \ln(X/P^*)_t .$$

Blanciforti, Green, and King call this model "The Linear Approximate Almost Ideal Demand System". In this study, $w_{i,t}$ is expenditure share of meat products type i. Both homogeneity and symmetry are imposed upon the model.

EXPENDITURE AND PRICE ELASTICITIES

The formulas for expenditures and price elasticities are

(5) $\mu = 1 + \beta_i/w_i$

and

(6) $e = -\delta_{ij} + \tau_{ij}/w_i - \beta_i w_j/w_i$

where δ_{ij} is the Kronecker delta (δ_{ij}=1 for all j=i and δ_{ij}=0 for all others). Equation (5) is the expenditure elasticity for the meat within the particular system studied. Equation (6) is the price elasticity as discussed in Green and Alston. The estimates for τ_{ij} and β_i can be obtained from the Linear Approximation model.

The first stage of the budgeting procedure is hypothesized to be

(7) $M_t = \Phi_0 + \Phi_1 \ln P_t^* + \Phi_2 \ln H_t + \Phi_3 RY_t$,

where Mt is the share of per capita income expended on all meats in the system in period t, P^*_t is as defined earlier, Yt is per capita income in period t, H_t is the price index of housing.

The elasticity of expenditures on all meats with respect to income, Ω, is

(8) $\Omega = 1 + \Phi_3/M_t$,

where Φ_3 is from (7) and M_t is the share of income expended on meats.

Income elasticities for the different types of meats can be found by

(9) $\theta = \mu_i \cdot \Omega$,

where θ_i is the income elasticity for the ith type of meat, μ_i is the expenditure elasticity for the ith type of meat, and Ω is the elasticity of expenditures on all meats with respect to income.

The models were estimated using Zellner's Seemingly Unrelated Regressions (SUR) with one equation in the system dropped due to the adding up restriction. There are no tests for structural changes due to the lack of data to fully estimate the extent of structural change. There are no tests of weak separability performed for the various groups of meat products due to the variety of systems tested.

DATA

The proper classification of slaughtered beef is based upon differences between class and quality components. Almost half of all carcasses produced in Japan are not graded, but due to the simultaneity in both production and decision making, graded beef is assumed to be reflective of the level of beef produced throughout Japan. Beef is divided into six different Wagyu grades and five different dairy grades. The reason for the difference is that dairy beef can not produce the marbling, or "sashi", required to be graded supreme. The majority of the cull cattle slaughtered is assumed to be utility beef, and middle grades are basically composed of grainfed heifers and steers.

The year 1974 was selected as the base year since the Japanese government restricted imports beginning in 1973. In 1973, the oil crisis hit the Japanese economy, and caused a fall in real incomes. The price of beef had fallen by more then thirty percent from the previous year as both the price of both feeder calves and imported feeds rose. In response to the threat of domestic beef production, the Japanese Government froze one half of the import quota for the remainder of 1973 and stopped imports for Japanese Fiscal Year (JFY) 1974. The Price Stabilization Law for Livestock Products was subsequently amended to include a beef price stabilization system and expanded the role of the LIPC in stabilizing domestic beef prices when the market was reopened in 1975. Since then, the market price of beef has remained fairly stable and imports have expanded, although total quantities have sometimes fluctuated (Fraser).

This gradual increase in imports continues through 1984. The end year of 1984 was selected due to an inability to obtain more recent data. Also, 1984 represents the beginning of the High Quality beef import quota dispute. Some researchers feel that the exclusion of the High Quality beef import quota would lead to biased estimates of market share and import expenditures (Lin, et al.).

The MAFF Meat Statistics in Japan was the primary source of domestic prices of both pork and poultry. Population figures are from MCA "Statistical Yearbook" for 1974-1984. Both the consumer price index and income are also from the "Statistical Yearbook". The use of the Japanese Consumer Price Index (CPI) to deflate nominal values is suggested by Lin, et al., due to the lack of the Wage Price Index to fully reflect Japanese prices. Income is nominal monthly household income, from 1974 to 1984, and is from the Statistical Yearbook of Japan, as well as housing costs. Exchange rates are from the UN Commodity Trade Statistics for 1974 to 1984. All imports are from the

UN Commodity Trade Statistics for the period of 1974 to 1984. These prices are originally expressed in dollars but are converted into Yen. All prices and slaughter are from the LIPC Beef Statistics in Japan.

Fish prices were calculated from the prices listed in the MCA Statistical Yearbook. Fish prices are disaggregated by the quality of the product, which corresponds to groupings of similar species of fish (Coyle 1983a). Fish is broken down into three broad groups: Luxury fish, (which includes tuna, salmon, trout, prawn); secondly, Table fish, (which includes crab meat, herring, squid, cod); and lastly, Lower quality fish, (which includes sardines, shark, pilchard, mackerel).

Coyle and Dyck, due to the control of the LIPC upon domestic prices, criticized studies which used beef prices that exist outside of the LIPC. This model uses domestic beef prices that are influenced by the LIPC, and then raises import prices to the LIPC level through the appropriate tariff and surcharges. All prices are farm gate prices, except for import prices, which are free on board (f.o.b.), corrected for the appropriate tariff and surcharges.

CHAPTER IV

EMPIRICAL RESULTS

In order to compare the models of Japanese demand for meat: (1) total demand for all meats is discussed, (2) the model of disaggregation by origin is discussed, and (3) the model using data disaggregation by quality is discussed. The demand for disaggregated meats in each model is first discussed by the broad origin or quality group. Each sub-group, which is a further disaggregation of either the broad origin or quality group, is then discussed.

TOTAL MEAT DEMAND

The estimated equation of the first stage expresses per capita share of income spent on all meats, M, as a function of the log of the real price of all meats (RPM), the log of real housing expenditures (RPH), and the log of real income (RY):

$$
\begin{array}{lllll}
(1)\quad M_t = & -0.0482 & + 0.0178\ RPM & - 0.0026\ RPH & + 0.0028\ RY \\
 & \{0.03706\} & \{0.0035\} & \{0.0042\} & \{0.0028\} \\
 & (-1.299) & (5.031) & (-0.605) & (0.938)
\end{array}
$$

$R^2 = .8362$ Durbin Watson d = 2.653, df = 7.

The numbers in brackets below the estimated coefficients are the estimated standard errors, while the numbers in parentheses are the estimated t-values. As indicated by the estimated Durbin Watson statistic, autocorrelation does not present a problem.

Multicollinearity may present a problem, because of the relatively high R^2 value, 0.8362, and the existence of two coefficients (own price and cross price) which are not significantly different from zero at the twenty percent significance level. However, no attempts were made in this study to correct for multicollinearity. It should be noted that insignificance may not be due to multicollinearity, but that the estimated coefficients may indeed be not signigicant from zero.

The estimated coefficient on income, Φ_3, is used to calculate the elasticity of expenditures of all meats, Ω, which is 1.1421 (equation (8)). The elasticity of expenditures is then used to calculate income elasticities for the remaining models.

ORIGIN DISAGGREGATION MODEL

The first model discussed is the demand for meats disaggregated by origin type. This demand system reflects other approaches (Hayes, et al., all Wahl, et al., Williams, and Lin, et al.) who examined demand, but assumed that disaggregation by origin would better reflect liberalization impacts and trade shares. The groups in this model are Wagyu, dairy, imported Beef, other meats (imported edible offal, imported horsemeat, imported sheepmeat, pork, and poultry), and fish.

The estimated coefficients of the broad origin model are presented in Table IV.1. The R^2 value for the entire model and the Durbin Watson statistics for each equation are presented also. Those coefficients which are not significantly different from zero at the twenty percent

Table IV.1. Estimated Coefficients of the Origin Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
Origin Model		WAGYU	DAIRY	IMPORTS	OTHER	FISH		
WAGYU	-1.0490	-0.0004	0.0279	0.0077	0.0305	-0.0657	0.0460	1.664
	{0.3018)	(0.0197)	{0.0119}	{0.0026}	{0.0290}	{0.0276}	{0.0127}	
	(-3.448)	(-0.018)	(2.351)	(2.908)	(1.050)	(-2.378)	(3.607)	
DAIRY	-0.8710	0.0279	-0.0010	-0.0031	-0.0399	0.0161	0.0380	2.114
	{0.4308}	{0.0119}	{0.0127}	{0.0025}	{0.0205}	{0.0226}	{0.0184}	
	(-2.021)	(2.351)	(-0.074)	(-1.269)	(-1.947)	(0.712)	(2.055)	
IMPORTS	-0.5920	0.0077	-0.0031	0.0045	-0.0439	0.0348	0.0260	2.067
	{0.0867}	{0.0026}	{0.0025}	{0.0008}	{0.0060}	{0.0067}	{0.0037}	
	(-6.827)	(2.908)	(-1.269)	(5.686)	(-7.283)	(5.167)	(6.889)	
OTHER	-3.1705	0.0305	-0.0399	-0.0439	1.0104	-0.9570	0.1416	1.831
	{0.5503}	{0.0290}	{0.0205}	{0.0060}	{0.0687}	{0.0705}	{0.0234}	
	(-5.761)	(1.050)	(-1.947)	(-7.283)	(14.699)	(-13.572)	(6.054)	
FISH	6.6820	-0.0657	0.0161	0.0348	-0.9570	0.9718	-0.2510	1.486
	{0.6960}	{0.0276}	{0.0226}	{0.0067}	{0.0705}	{0.0763}	{0.0297}	
	(9.600)	(-2.378)	(0.712)	(5.167)	(-13.572)	(12.735)	(-8.445)	

$R^2 = 0.9687$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

level are assumed to be zero when calculating elasticities. The reported critical value of the t-statistic is for a two-tailed test.

There are eight estimated coefficients that are not significantly from zero. Therefore, the problem of multicollinearity may exist. Autocorrelation presents no problem to the model, as indicated by the calculated Durbin-Watson statistics.

The elasticities calculated from the estimated model using data disaggregated by origin are presented in Table IV.2. This includes the elasticities from the origin model sub-groups also. All estimated coefficients which were not significantly differnt from zero were set equal to zero when calculating the elasticities.

The own price elasticities are not all of the expected sign. Both the own price elasticities for the other meat category and the fish category have positive signs. The own price elasticities of Wagyu (-0.9540) and dairy beef (-0.9620) are very similar. The own price elasticity for imports (-0.7081) is lower than that for Wagyu or dairy beef.

As indicated by the positive cross price elasticities, dairy beef and Wagyu appeared to be substitutes for each other, as were Wagyu and imported beef, and dairy beef and imported beef. The calculated elasticities suggest that fish, as an aggregate, is a substitute for dairy and imported beef, but not for Wagyu beef. The elasticities of the dairy beef and imported beef with respect to the price of other meats were all negative.

The income elasticities all have the expected signs. All meats are considered to be luxury goods, except fish, which is considered a

Table IV.2. The Elastiticities of the Origin Model and Its Sub-groups

Model or Sub-Group Model	PRICE ELASTICITIES					EXPENDITURE	INCOME
Origin Model	WAGYU	DAIRY	IMPORTS	OTHER	FISH		
WAGYU	-0.9540	0.8519	0.8428	0.0000	-0.0747	2.6429	3.0185
DAIRY	1.0523	-0.9620	0.0884	-0.6435	0.0014	2.1176	2.4185
IMPORTS	0.2914	0.0112	-0.5240	-0.7081	0.0406	3.6000	3.2742
OTHER	0.1019	-1.1042	-4.2288	15.2952	-1.1026	3.2742	4.1116
FISH	-0.9237	0.9679	5.7316	-15.4355	0.1570	0.7102	0.8111
Wagyu Sub-group	SUPREME	EXCELL	MEDIUM	COMMON	UTILITY		
SUPREME	-1.0620	-0.0877	0.4746	-0.9805	0.0000	0.2874	0.8675
EXCELLENT	-0.1689	-1.2390	0.0000	0.0000	0.0000	-0.0084	-0.2535
MEDIUM	2.1484	-0.4568	-2.3687	4.1039	0.0000	1.0000	3.0185
COMMON	-1.8454	-0.1553	1.3951	-4.8571	0.0000	3.5714	10.7802
UTILITY	-0.0492	-0.0696	0.0000	0.0000	-1.0000	1.0000	3.0185
Dairy Sub-group	SUPERIOR	EXCELL	MEDIUM	COMMON	UTILITY		
SUPERIOR	0.7677	0.0000	-0.0370	0.0123	0.0248	2.7647	6.6860
EXCELLENT	0.0305	2.5838	0.0052	0.0000	0.0000	1.0000	2.4185
MEDIUM	-7.5762	0.0000	-0.8870	0.0000	0.0000	1.3025	3.1500
COMMON	3.6578	0.0000	0.1229	0.0244	-2.8997	1.1650	2.8176
UTILITY	3.2966	0.0000	0.0609	-1.4381	1.4975	0.0467	0.1129
Imported Beef Sub-group	AUS	NZ	US				
AUSTRALIA	-1.0880	0.0000	0.2236			0.8725	3.5870
NEW ZEALAND	-0.0064	-2.5400	0.2362			1.0000	4.1116
UNITED STATES	-0.0319	1.1000	-0.9190			1.3240	5.4438

Table IV.2. The Elastiticities of the Origin Model and Its Sub-groups, Continued

Model or Sub-Group Model	PRICE ELASTICITIES					EXPENDITURE	INCOME
Other Sub-group	OFFAL	HORSE	LAMB	PORK	CHICKEN		
EDIBLE OFFAL	-0.9420	0.3560	0.0000	0.0000	-0.0767	1.9667	7.3540
HORSEMEAT	0.5510	-1.0680	0.0000	0.0000	0.0142	0.0286	0.1069
LAMB AND MUTTON	0.0387	-0.0389	-1.0000	-0.6400	0.2113	1.0000	3.7395
PORK	0.0193	-0.0194	-3.2000	-1.9550	0.4914	2.8100	10.5080
CHICKEN	-0.3243	-0.6120	3.2000	1.5350	-1.4260	0.3762	1.4068
Fish Sub-group	HQ	TQ	CQ				
HIGH QUALITY	-0.3047	-0.4847	-0.5811			1.0000	0.8111
TABLE QUALTIY	-0.3648	-0.1083	-0.1774			1.3160	1.0670
CHEAP QUALITY	-0.3305	-0.0910	-0.2415			1.0000	0.8111

normal good. However, imported beef has a higher income (3.2742) elasticity than either Wagyu, (3.0185), or dairy beef, (2.4185). It appears that as expenditures increase, less fish is consumed in comparison to the red meat groups.

The estimated sub-systems for each one of the various sub-groups will be discussed next. The first sub-group model discussed is the sub-group model for Wagyu, disaggregated by grade, followed by dairy sub-group model, disaggregated by grade. Imported beef is disaggregated by country of origin. The other meats are disaggregated into basic meat groups, including chicken, pork, edible offal, imported horsemeat, and imported lamb and mutton. The fish sub-group is disaggregated into quality levels.

WAGYU ORIGIN MODEL

The estimated coefficients for the Wagyu sub-group are shown in Table IV.3. The two top grades, supreme and superior, are combined into one grade, designated as supreme. This combination should not greatly change the overall estimates due to the similarity of these two grades in production and marketing of the graded carcasses.

The possibility of multicollinearity is reflected by the number of insignificant variables, twenty-one of the thirty-five estimated coefficients were not significantly different from zero. Autocorrelation does not present a problem in this model.

The elasticities of the Wagyu sub-group model are presented in Table IV.2. The own price elasticities all possess the expected sign.

Table IV.3. Estimated Coefficients of the Wagyu Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
Wagyu Sub-group		SUPREME	EXCELL	MEDIUM	COMMON	UTILITY		
SUPREME	1.2700	-0.0250	-0.0890	0.2150	-0.1510	0.0500	-0.062	1.918
	{0.1670}	{0.0372}	{0.0839}	{0.0830}	{0.0618}	{0.0364}	{0.0092}	
	(7.629)	(-0.701)	(-1.058)	(2.596)	(-2.440)	(1.382)	(-6.779)	
EXCELLENT	4.7700	-0.0890	0.1330	-0.1050	0.0370	0.0240	-0.239	1.132
	{0.7404}	{0.0839}	{0.2248}	{0.2576}	{0.2010}	{0.1128}	{0.0404}	
	(6.442)	(-1.058)	(0.585)	(-0.406)	(0.186)	(0.217)	(-5.928)	
MEDIUM	1.3600	0.2150	-0.1050	-0.6200	0.6320	-0.1220	-0.048	1.210
	{0.9338}	{0.0830}	{0.2576}	{0.3765}	{0.3028}	{0.1699}	{0.0512}	
	(1.459)	(2.596)	(-0.406)	(-1.646)	(2.086)	(-0.721)	(-0.933)	
COMMON	-7.3300	-0.1510	0.0370	0.6320	-0.5940	0.0760	0.396	1.291
	{0.9197}	{0.0618}	{0.2010}	{0.3028}	{0.2995}	{0.1689}	{0.0504}	
	(-7.973)	(-2.440)	(0.186)	(2.086)	(-1.983)	(0.450)	(7.865)	
UTILITY	0.9300	0.0500	0.0240	-0.1220	0.0760	-0.0280	-0.047	1.417
	{0.7500}	{0.0364}	{0.1128}	{0.1699}	{0.1689}	{0.1220}	{0.0410}	
	(1.235)	(1.382)	(0.217)	(-0.721)	(0.450)	(-0.231)	(-1.138)	

$R^2 = 0.9113$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

The cross price elasticities have some unexpected signs. While the grades common and medium are substitutes, and the grades supreme and medium are substitutes, the other grades have negative cross price elasticities. This suggests that these other grades are complements.

The expenditure and income elasticities are all of expected signs except for the elasticity for Wagyu grade excellent. The magnitudes of the income elasticities are somewhat unexpected, since an increasing magnitude of the income elasticity with increasing quality might be expected, instead of a decreasing elasticities from lower to higher grades. It appears that as expenditures increase, there is a shift towards the lower quality Wagyu grades.

DAIRY ORIGIN MODEL

The next sub-model discussed is disaggregated dairy grade. The estimated coefficients are presented in Table IV.4. The estimated coefficients indicated that multicollinearity may again be a problem due the number of estimated coefficients which are not significant from zero (sixteen of the estimated thirty-five coefficients).

The reported elasticities are represented in Table IV.2. Only dairy medium grade had the correct expected sign for own price elasticity. The other dairy grades all had positive signs. The cross price elasticities imply dairy beef grades common, utility, and superior are, for the most part, substitutes for each other. The exceptions within these grades are that utility grade does not substitute for common grade, but is a complement of both dairy medium and dairy

Table IV.4. Estimated Coefficients of the Dairy Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
		SUPERIOR	EXCELL	MEDIUM	COMMON	UTILITY		
Dairy Sub-group								
SUPERIOR	-0.0530	0.0030	0.0010	-0.0140	0.0050	0.0050	0.003	2.221
	{0.1067}	{0.0002}	{0.0010}	{0.0038}	{0.0029}	{0.0020}	{0.0005}	
	(-5.041)	(12.509)	(1.134)	(-3.674)	(1.773)	(2.663)	(5.645)	
EXCELLENT	-0.1580	0.0010	0.0620	-0.1260	0.0690	-0.0060	0.009	2.284
	{0.1530}	{0.0010}	{0.0396}	{0.0967}	{0.0559}	{0.0440}	{0.0078}	
	(-1.032)	(1.134)	(1.558)	(-1.301)	(1.235)	(-0.138)	(1.114)	
MEDIUM	-1.7530	-0.0140	-0.1260	-0.0360	0.0940	0.0820	0.113	2.038
	{0.7741}	{0.0038}	{0.0967}	{0.3635}	{0.2032}	{0.1958}	{0.0391}	
	(-2.264)	(-3.674)	(-1.301)	(-0.009)	(0.463)	(0.418)	(2.905)	
COMMON	-1.1110	0.0050	0.0690	0.0940	0.4160	-0.5840	0.067	2.275
	{0.5482}	{0.0029}	{0.0559}	{0.2032}	{0.1589}	{0.1071}	{0.0278}	
	(-2.026)	(1.773)	(1.235)	(0.463)	(2.615)	(-5.450)	(2.414)	
UTILITY	4.0750	0.0050	-0.0060	0.0820	-0.5840	0.5030	-0.192	1.809
	{0.4579}	{0.0020}	{0.0440}	{0.1958}	{0.1071}	{0.1455}	{0.0232}	
	(8.901)	(2.663)	(-0.138)	(0.418)	(-5.450)	(3.455)	(-8.284)	

$R^2 = 0.9912$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

superior grades. The other grades in the model had zero cross price elasticities.

The income elasticities of dairy beef imply that nearly all dairy beef may be considered to be a luxury goods (Table IV.2). The exception is dairy utility, which is considered a normal good. The income elasticities increase with the quality levels as would be expected. As expenditures increase, the Japanese consumer consumes more higher quality dairy beef.

IMPORTED BEEF ORIGIN MODEL

The imported beef sub-group has the lowest R^2 value (0.4727) in the origin model (Table IV.5). However, there are still ten estimated coefficients that are not significantly different from zero (out of fifteen estimated coefficients). This implies that multicollinearity or model misspecification may present a problem. However, autocorrelation does not present a problem.

The elasticities of the third sub-model, for imported beef, are presented in Table IV.2 (page 41). The own price elasticities all had the expected signs. The own price elasticity of the New Zealand beef (-2.5400) is larger than either the elasticity of Australian beef (-1.0880) or US beef (-0.9190). The cross price elasticities indicate that U.S. beef is a complement for Australian beef but is a substitute of New Zealand beef. New Zealand beef appears to substitute for U.S. beef, but Australian beef is a complement of American beef. This may be the result of the benefits that the US has enjoyed in recent

Table IV.5. Estimated Coefficients of the Imported Beef Sub-group model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES			BETA	DURBIN WATSON
Imported Beef Sub-group		AUS	NZ	US		
AUSTRALIA	2.3208	0.0020	0.0220	-0.0240	-0.0880	0.939
	{0.8899}	{0.8410}	{0.0437}	{0.0758}	{0.0471}	
	(2.608)	(0.024)	(0.498)	(-0.314)	(-1.865)	
NEW ZEALAND	-0.0888	0.0220	-0.0770	-0.0550	0.0070	2.873
	{0.2325}	{0.0437}	{0.0505}	{0.2167}	{0.0124}	
	(-0.382)	(0.498)	(-1.528)	(2.557)	(0.567)	
UNITED STATES	-1.2320	-0.0240	0.0550	-0.0310	0.0810	1.041
	{0.9006}	{0.0758}	{0.2167}	{0.0770}	{0.0478}	
	(-1.368)	(-0.314)	(2.557)	(-0.410)	(1.701)	

$R^2 = 0.4727$ Crictical t-value = 1.754[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 15 degrees of freedom at the twenty percent level (two-tailed test).

years in response to pressure to liberalize the Japanese market (Fraser, Lin, et al.) This shift may reflect the associated advantage rather than the actual preference of US beef. However, as expenditures increase, the US beef is consumed more than either Australian or New Zealand beef.

The income elasticities indicate that all imported beef grades are considered luxury items. The income and expenditure elasticities for U.S. beef are greater than those for the beef from the two other countries.

OTHER MEATS ORIGIN MODEL

The next sub-group modeled is other meats, consisting of imported edible offal, imported horsemeat, imported lamb and mutton, pork and chicken. Table IV.6 presents the estimated coefficients of the other meats model. The number of insignificant values coupled with the high R^2 (0.9713) suggests that multicollinearity may present a problem.

The elasticities are reported in Table IV.2 (page 41). The own price elasticities are all of the expected sign. The smallest signs are for the imported processing meats (imported edible offal and imported lamb and mutton). The cross price elasticities show that the only meat that is a substitute for imported offal is imported horsemeat. Chicken and imported offal are substitutes for imported horsemeat. Chicken competes as a substitute for both pork and imported lamb and mutton. However, a number of complements do exist in this sub-group primarily

Table IV.6. Estimated Coefficients of the Other Meats Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
		IEO	IHO	ILM	PORK	CHICKEN		
Other Meat Sub-group								
EDIBLE OFFAL	-1.1880	0.0260	0.0290	-0.0040	0.0050	-0.0560	0.0580	1.826
	{0.2898}	{0.0212}	{0.0143}	{0.0115}	{0.0450}	{0.0351}	{0.0149}	
	(-4.099)	(1.241)	(2.004)	(-0.333)	(0.112)	(-1.604)	(3.885)	
HORSEMEAT	1.4490	0.0290	-0.0070	0.0010	0.0070	-0.0300	-0.0680	2.843
	{0.2355}	{0.0143}	{0.0159}	{0.0102}	{0.0297}	{0.0260}	{0.0120}	
	(6.153)	(2.004)	(-0.388)	(0.094)	(0.232)	(-1.171)	(-5.717)	
LAMB AND MUTTON	-0.6630	-0.0040	0.0010	0.0030	-0.1280	0.1280	0.0410	0.840
	{0.5773}	{0.0116}	{0.0102}	{0.0241}	{0.0288}	{0.0405}	{0.0280}	
	(-1.148)	(-0.333)	(0.094)	(0.128)	(-4.445)	(3.158)	(1.451)	
PORK	-7.2150	0.0050	0.0070	-0.1280	-0.1910	0.3070	0.3620	2.182
	{0.8227}	{0.0450}	{0.0297}	{0.0288}	{0.1185}	{0.0937}	{0.0425}	
	(-8.770)	(0.112)	(0.232)	(-4.445)	(-1.614)	(3.279)	(8.530)	
CHICKEN	8.6170	-0.0560	-0.0300	0.1280	0.3070	-0.3490	-0.3930	1.469
	{1.0976}	{0.0351}	{0.0260}	{0.0405}	{0.0937}	{0.0960}	{0.0543}	
	(7.851)	(-1.604)	(-1.171)	(3.158)	(3.279)	(-3.631)	(-7.223)	

$R^2 = 0.9713$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

between the imported processing meats and the domestic meat items (pork and chicken.)

There is clearly a shift away for imported processing meats and chicken towards imported edible offal and pork as expenditures are increase. The income elasticities suggest that all other meats are normal goods. Further, all other meats, except imported horsemeat, are considered luxury goods.

FISH ORIGIN MODEL

The last origin sub-group is fish grouped in levels of quality. The estimated coefficients are reported in Table IV.7. Again, multicollinearity may be a problem, but autocorrelation is not.

The elasticities for the fish sub-group model are presented in Table IV.2 (page 41). The own price effects for each fish group have the correct sign. The cross price effects, however, do not have the expected signs. These signs indicate that each fish group is a complement of every other fish group. All fish groups are viewed as a normal goods, having positive income elasticities. However, the high quality fish was expected to be considered a luxury good, rather than just a normal good (0.8111).

QUALITY DISAGGREGATION MODEL

The first model examined is the model where meats are aggregated into broad quality groups: 1) high quality, 2) table quality, and 3) low

Table IV.7. Estimated Coefficients of the Fish Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES			BETA	DURBIN WATSON
		HQ	TQ	CQ		
Fish Sub-group						
HIGH QUALITY	3.3070	0.3240	-0.1700	-0.1540	-0.1510	0.910
	{2.455}	{0.0560}	{0.3765}	{0.0188}	{0.1115}	
	(1.347)	(5.783)	(-4.505)	(-8.184)	(-1.354)	
TABLE QUALTIY	-1.4380	-0.1700	0.2170	-0.0470	0.0850	0.920
	{1.666}	{0.0376}	{0.0258}	{0.0127}	{0.0756}	
	(-0.863)	(-4.505)	(8.390)	(-3.681)	(1.128)	
CHEAP QUALITY	-0.8690	-0.1540	-0.0470	0.2010	0.0660	0.943
	{0.8337}	{0.0188}	{0.0127}	{0.0067}	{0.0378}	
	(-1.043)	(-8.184)	(-3.681)	(29.747)	(1.734)	

$R^2 = 0.9977$ Critical t-value = 1.753[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 15 degrees of freedom at the twenty percent level (two-tailed test).

quality. The estimated coefficients are reported in Table IV.8. There appears to be little problem with multicollinearity, as there are only two coefficients that were not significantly different from zero.
The elasticities for the model which is aggregated by quality groups are presented in Table IV.9. The own price elasticities for both high quality meats and low quality meats are of the expected sign. The sign of the own price elasticity of table quality meat is positive, but the elasticity is small, (0.011), especially when compared to the other meats in the model.

The cross price elasticities show that low and table quality meats are both complements of the higher quality group. These two groups (low and table) compete as substitutes. The income elasticities are positive. However, when disaggregated by type, high quality meat is expected to be luxury good, not just a normal good (0.0468). Both table quality and low quality are indeed considered to be luxury goods (1.7289 and 1.4962, respectively). It should be noted that as expenditures increase, there is a shift away from purchasing the higher quality items to the table quality and lower quality groups.

HIGH QUALITY MODEL

The high quality aggregation reflects those meats which are assumed to be close in quality, and weakly separable from other meats in the model. The high quality group consists of the following meats: Wagyu supreme, superior, excellent, dairy superior, and high quality fish. The estimated coefficients are presented in Table IV.10. Many of

Table IV.8. Estimated Coefficients of the Quality Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES			BETA	DURBIN WATSON
		HQ	TQ	CQ		
Quality Model						
HIGH QUALITY	5.3200	0.4100	-0.2200	-0.1900	-0.242	1.123
	{1.7854}	{0.0851}	{0.0617}	{0.0332}	{0.0814}	
	(2.980)	(4.860)	(-3.578)	(-5.803)	(-2.977)	
TABLE QUALITY	-2.8800	-0.2200	0.2500	-0.0300	0.149	1.444
	{1.4473}	{0.0617}	{0.0574}	{0.0264}	{0.0656}	
	(-1.987)	(-3.578)	(4.390)	(-1.180)	(2.277)	
CHEAP QUALITY	-1.4400	-0.1900	-0.0300	0.2200	0.093	0.958
	{0.7441}	{0.0332}	{0.0264}	{0.0163}	{0.0337}	
	(-1.941)	(-5.803)	(-1.180)	(13.723)	(2.761)	

$R^2 = 0.9580$ Critical t-value = 1.753[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 15 degrees of freedom at the twenty percent level (two-tailed test).

Table IV.9. The Elastiticities of the Quality Model and Its Sub-groups[a]

Model or Sub-Group Model	PRICE ELASTICITIES					EXPENDITURE	INCOME
Quality Model	HQ	TQ	CQ				
HIGH QUALITY	-0.2420	-0.5480	-0.5062			0.4098	0.4098
TABLE QUALITY	-0.7078	0.0111	0.0899			1.5138	1.7289
CHEAP QUALITY	-0.6405	0.1541	-0.1737			1.3100	1.4962
High Quality Sub-group	W SUPRE	W SUPER	W EXCEL	D SUPER	FISHHQ		
W SUPREME	-1.0000	-0.0018	-0.0031	0.0000	0.0000	1.0000	0.0468
W SUPERIOR	0.0000	-1.0050	0.3030	0.0000	0.0000	-0.1905	-0.0089
W EXCELLENT	0.0000	1.1245	-1.0320	0.0000	0.0000	-1.0779	-0.0504
D SUPERIOR	0.0000	-0.0001	-0.0002	-1.0000	0.0013	1.0000	0.0468
FISHHQ	0.0000	-1.1643	-2.0322	13.0000	-1.0000	1.0399	0.0487
Table Quality Sub-group	IMPORT	OFFAL	PORK	BEEF	FISHTQ		
IMPORTED BEEF	-0.7077	-0.2175	-1.4068	0.2955	-0.0064	1.5588	2.6950
EDIBLE OFFAL	-0.0704	-0.3550	0.2907	-0.1364	-0.0020	1.6250	2.8095
PORK	-0.2678	0.0075	6.1923	0.0000	-0.0637	10.0833	17.4330
DOMESTIC BEEF	0.1520	-0.1600	0.3997	0.6818	-0.0954	4.1136	7.1120
FISHTQ	0.4526	0.5063	3.1075	-1.7045	-0.8893	0.6012	1.0394
Cheap Quality Sub-group	WAGYU	DAIRY	IMPORTS	CHICKEN	FISHCQ		
WAGYU UTILITY	-2.6667	0.1862	-0.2815	0.0630	-0.0052	1.0000	1.4962
DAIRY	2.0000	-0.1001	0.7207	0.0000	-0.1026	2.1791	3.2604
PROCESS IMPORTS	-1.0000	0.2946	-1.0320	0.0000	-0.0158	-0.4545	-0.6800
CHICKEN	1.3333	0.1497	-0.1847	-0.5827	-0.0804	1.3071	1.9557
FISHCQ	-0.6667	-0.2618	-1.6771	-0.4803	-0.8115	0.8830	1.3211

Table IV.10. Estimated Coefficients of the High Quality Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
High Quality Sub-group		W SUPRE	W SUPER	W EXCEL	D SUPER	FISHHQ		
W SUPREME	0.0210	-0.0005	-0.0007	0.0016	-0.0004	0.0000	-0.0010	1.295
	{0.0209}	{0.0006}	{0.0007}	{0.0019}	{0.0004}	{0.0010}	{0.0010}	
	(1.010)	(-0.905)	(-1.073)	(0.849)	(-0.867)	(0.030)	(-9.920)	
W SUPERIOR	0.1180	-0.0007	-0.0015	0.0048	-0.0002	-0.0024	-0.0050	1.880
	{0.0400}	{0.0007}	{0.0014}	{0.0030}	{0.0005}	{0.0018}	{0.0019}	
	(2.949)	(-1.073)	(-1.059)	(1.622)	(-0.349)	(-1.351)	(-2.799)	
W EXCELLENT	0.6870	0.0016	0.0048	-0.0050	-0.0008	-0.0007	-0.0320	1.563
	{0.1976}	{0.0019}	{0.0030}	{0.0104}	{0.0016}	{0.0087}	{0.0094}	
	(3.480)	(0.849)	(1.622)	(-0.479)	(-0.451)	(-0.078)	(-3.384)	
D SUPERIOR	0.0180	-0.0004	-0.0002	-0.0008	0.0001	0.0013	-0.0009	0.971
	{0.0144}	{0.0004}	{0.0005}	{0.0017}	{0.0004}	{0.0007}	{0.0007}	
	(1.256)	(-0.867)	(-0.349)	(-0.451)	(0.130)	(1.750)	(-1.243)	
FISHHQ	0.0156	0.0000	-0.0024	-0.0007	0.0013	0.0018	0.0390	1.599
	{0.2335}	{0.0010}	{0.0018}	{0.0087}	{0.0007}	{0.0101}	{0.1111}	
	(0.666)	(0.030)	(-1.351)	(-0.078)	(1.750)	(0.177)	(3.505)	

$R^2 = 0.9551$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

the estimated coefficients in the model were not significantly different from zero, coupled with the high R^2 value, (0.9551), suggesting that multicollinearity may be present in this model.

Table IV.9 presents the elasticities of the high quality model. The own price effects for this model were as expected. The cross price elasticities show that most meats in this model are complements. The only two substitutes are Wagyu excellent and Wagyu superior, and High quality fish and dairy superior.

The expenditure elasticities are all small, but there exists no clear preference for any one meat item as expenditures are increased. The associated income elasticities are also small. There are two meats which had negative signs which was not expected (Wagyu superior and Wagyu excellent).

TABLE QUALITY MODEL

The table quality meats model is composed of Wagyu grades (medium and common) and dairy grades (excellent, medium, and common). The other goods in this model are pork, table quality fish, imported edible offal, and imported beef (represents aggregated beef imports). The estimated coefficents are presented in Table IV.11. The system R^2 of 0.9692 and the number of coefficients (eight of the thirty-five) which were not significantly different from zero indicates that multicollineatiy may exist. Autocorrelation does not present a problem.

The elasticities are presented in Table IV.9. The own price effects for imported beef, imported edible offal, and fish all possess

Table IV.11. Estimated Coefficients of the Table Quality Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
Table Quality Sub-group		IMPORTS	OFFAL	PORK	BEEF	FISHTQ		
IMPORTS	-1.2430	0.0240	-0.0090	-0.0280	0.0136	0.0001	0.057	2.313
	{0.0970}	{0.0017}	{0.0014}	{0.0046}	{0.0037}	{0.0051}	{0.0044}	
	(-12.804)	(14.022)	(-6.804)	(-6.023)	(3.679)	(-0.021)	(12.900)	
EDIBLE OFFAL	-0.4270	-0.0090	0.0200	0.0003	-0.0060	-0.0050	0.020	1.988
	{0.0766}	{0.0014}	{0.0026}	{0.0029}	{0.0033}	{0.0049}	{0.0035}	
	(-5.572)	(-6.804)	(7.185)	(-0.128)	(-1.748)	(-0.927)	(5.778)	
PORK	-2.3440	-0.0280	0.0003	0.0850	-0.0060	-0.0510	0.109	2.316
	{0.5996}	{0.0046}	{0.0029}	{0.0309}	{0.0147}	{0.0259}	{0.0273}	
	(-3.911)	(-6.023)	(-0.128)	(2.788)	(-0.440)	(-1.988)	(3.974)	
DOMESTIC BEEF	-2.9870	0.0136	-0.0060	-0.0060	0.0740	-0.0750	0.137	2.490
	{0.2933}	{0.0037}	{0.0033}	{0.0147}	{0.0158}	{0.0170}	{0.0135}	
	(-10.183)	(3.679)	(-1.748)	(-0.440)	(4.659)	(-4.418)	(10.184)	
FISHTQ	8.0010	0.0001	-0.0050	-0.0510	-0.0750	0.1310	-0.323	2.127
	{0.5138}	{0.0051}	{0.0049}	{0.0259}	{0.0170}	{0.0289}	{0.0234}	
	(15.574)	(-0.021)	(-0.927)	(-1.988)	(-4.418)	(4.531)	(-13.797)	

$R^2 = 0.9692$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

the expected sign. However, pork and chicken each have positive signs (6.1923 and 0.6818, respectively).

The cross price effects of imported beef suggest that imported beef is a complement of the other meats in the model except for domestic beef and table quality fish. Imported edible offal is a substitute for table fish and pork but is a complement of domestic beef and imported beef. Domestic beef appears to be a complement of imported edible offal and fish, and competes as a substitute with imported beef.

There may be a preference for domestic meats in this model, as the expeniture elasticities of the various meat items appear to have similar values. However, the fish expenditure elasticity is small, and may reflect a movement away from fish purchases as expenditures increase. The income elasticities suggest that all of these meats are luxury goods, but there is some concern over the pig coefficient of 17.4330.

LOW QUALITY MODEL

The next model is the low quality meat model composed of Wagyu utility, dairy common and utility, horsemeat and lamb meat, poultry and fish. The low quality meats model consists largely of the lower quality meats consumed in Japan. These meats are Wagyu utility, dairy beef (common and utility), imported meats (horsemeat and sheepmeat), lower quality fish, and chicken. Table IV.12 presents the estimated ocefficients. The R^2 value, (0.9414), and the number of estimated coefficients not significantly different from zero suggest that some level of multicollinearity may exist.

Table IV.12. Estimated Coefficients of the Low Quality Sub-group Model[a]

Model or Sub-Group Model	ALPHA	COEFFICIENTS OF PRICES					BETA	DURBIN WATSON
Low Quality Sub-group		WAGYU	DAIRY	IMPORTS	CHICKEN	FISHCQ		
WAGYU UTILITY	-0.1190	-0.0100	0.0120	-0.0060	0.0080	-0.0040	0.005	1.609
	{0.0857}	{0.0040}	{0.0036}	{0.0011}	{0.0012}	{0.0015}	{0.0037}	
	(-1.394)	(-2.681)	(3.352)	(-5.108)	(6.966)	(-2.773)	(1.473)	
DAIRY MEATS	-1.7940	0.0120	0.0550	0.0180	-0.0060	-0.0790	0.079	2.184
	{0.6832}	{0.0036}	{0.0135}	{0.0044}	{0.0058}	{0.0144}	{0.0297}	
	(-2.626)	(3.352)	(4.086)	(3.957)	(-1.019)	(-5.473)	(2.646)	
PROCESSING IMPORTS	0.7450	-0.0060	0.0180	-0.0060	0.0060	-0.0120	-0.032	1.712
	{0.2612}	{0.0011}	{0.0044}	{0.0041}	{0.0041}	{0.0051}	{0.0115}	
	(2.854)	(-5.108)	(3.957)	(-1.427)	(1.435)	(-2.313)	(-2.830)	
CHICKEN	-0.7600	0.0080	-0.0060	0.0060	0.0530	-0.0610	0.039	1.946
	{0.3620}	{0.0012}	{0.0058}	{0.0041}	{0.0068}	{0.0059}	{0.0160}	
	(-2.101)	(6.966)	(-1.019)	(1.435)	(7.667)	(-10.234)	(2.453)	
FISHCQ	2.9280	-0.0040	-0.0790	-0.0120	-0.0610	0.1560	-0.091	1.714
	{0.8487}	{0.0015}	{0.0144}	{0.0051}	{0.0059}	{0.0180}	{0.0369}	
	(3.450)	(-2.773)	(-5.473)	(-2.313)	(-10.234)	(8.640)	(-2.462)	

$R^2 = 0.9414$ Critical t-value = 1.706[b]

[a] The numbers in the brackets are the standard error. The numbers in parenthesis are the t-values.

[b] The reported critical t-value is for 26 degrees of freedom at the twenty percent level (two-tailed test).

The elasticities of the low quality sub-group is reported in Table IV.9 (page 55). The own price elasticities all possess the expected sign. The cross price elasticities of Wagyu utility suggest that it is a complement of imported processing meats (-0.2815) and fish (-0.0052). The cross price effects of imported processing meats with respect to the price of dairy beef suggest that they are substitutes. Chicken is a substitute for both Wagyu and dairy beef but is either a complement or unrelated to all other meats in the model.

The expenditure elasticities indicate a increase in dairy consumption as expenditures increase, but a decrease in processing meat consumption. The other meats in the model have similar expenditure elasticities. The income elasticities imply that imported processing meats are inferior goods and that all other meat types may be viewed as luxury meats.

CHAPTER V

SUMMARY AND CONCLUSION

COMPARISON OF THE ORIGIN AND QUALITY MODELS

A comparison of results from the two models would help to present a clearer picture of the relationship between the different types of meats that are demanded by the Japanese consumer. Longworth hypothesized that the Japanese consumer prefers the heavier marbled product, but the perceived strong demand for these luxury meats on a carcass level may be deceptive. The relative value of the "super" cuts of meat lies within certain specific cuts, and the value of these cuts determines the value of the carcass. There is clearly a premium paid for this additional marbling.

The elasticities from the origin model indicate that Wagyu has both a higher income and expenditure elasticity than dairy beef. This would be expected as the Wagyu beef is assumed to be a more heavily marbled product. However, in the Wagyu sub-group, the expenditure elasticities for Wagyu were low for the Wagyu grade supreme, and negative for Wagyu grade excellent. These signs may indicate that the Japanese consumer desires more meat, and may not perceive the differences in quality as suggested. In the dairy model, the expenditure elasticities are as expected.

The overall high quality group, which includes Wagyu grades supreme, superior, excellent, and dairy grade superior, had positive expenditure and income elasticities. However, when expenditures on the high quality model increased, there was a decrease in the expenditures of the Wagyu grades excellent and superior. This could be the result of the demand for the higher marbled Wagyu grade supreme.

This discrepancy, both in the magnitude and the sign of the expenditure and income elasticities, may be the result of multicollinearity. The collinearity amongst prices may be the result of similar price movements (Ospina and Shumway), caused primarily by the heavy emphasis upon achieving the heavier, more marbled carcass. The Japanese producer feeds his cattle to the heavier wieghts in anticipation of recieving a higher grade. Thus, the Japanese producer bases his decisions upon the anticipated price of higher grades, and not upon the price grade of the carcass that is being produced. However, because a number of variables is not significant from zero may mean just that rather than multicollinearity existing in the model.

It is possible that disaggregation of quality meats should be between composite groups of luxury items that are more separable than the aggregation used here. Inability to use data on specific cuts may result in biases in the estimated coefficients. This failure to examine disaggregated quality, however, could lead to misspecification of the higher quality meat variables, producing underestimation of the relative value of these meats. This misspecification could possibly result in an incorporation of bias of the relative value of other meats in the model. Those meats that only compete with the lower quality beef grades would be underestimated when compared to the aggregated beef groups, as the higher valued beef items are included, which conceals the actual competing products.

By failing to examine the disaggregated meats by either origin or quality type, it is hard to clearly define the different meat items that a particular good may compete with. The inclusion of the various grades of beef illustrates that beef within the origin model is clearly of a higher value than that of the other meats group. The failure to estimate the imported processing meats to the lower quality beef products, but rather an aggregated beef variable, would possibly show that the two items do not directly compete. However, when the model is disaggregated by quality groups, those meats that are low in quality become complements and substitutes for other meats.

In origin models, the primary disaggregation used in other studies has been Wagyu beef compared to a composite group of dairy beef and imported beef (Hayes, et al., all Wahl, et al.,) or imported beef compared to dairy beef only (Lin, et al.). This type of disaggregation is supported by the work of Mori and Gorman (1985, 1987), who argued that dairy beef is a more closely related product than Wagyu beef when compared to imported beef.

Hayes, et al., and all Wahl, et al., report similar results, with only changes in the absolute value of each elasticity, but no significant changes in the signs of the elasticities. They concluded that imported quality beef was a substitute of Wagyu beef (0.32), pork (0.36), chicken (0.11) and fish (0.20). Wagyu beef was a substitute of the same meat groups (imported beef (0.49), pork (0.95), chicken (0.16), and fish (0.47)). Lin, et al., reported that imported beef was a substitute of domestic dairy (1.38) and pork (0.25), but a complement of fish (-0.05). In an effort to remove possible multicollinearity both Wagyu beef and poultry were excluded from the model. However, dairy beef was assumed to a proxy for Wagyu beef, and pork served as a proxy for poultry.

When comparing these studies to the estimated elasticities reported here, imported beef is a close substitute for Wagyu beef (0.8428), but not for dairy beef (0.0884). The differences between this estimate and the elasticities reported by Hayes, et al., may reflect the exclusion of dairy beef in the imported beef estimates. The cross price elasticity of Wagyu beef indicates that dairy beef is a closer substitute of Wagyu beef (1.0523) than imported beef (0.2914).

Due to the recent signing of the Beef Market Access Agreement, the role of imported beef has been debated as to its relative value in the Japanese market. By examining imported beef on the aggregated level, as done by Hayes, et al., Lin, et al., imported beef has been reported as a substitute of aggregated Wagyu and dairy beef. The grades of domestic beef and the relative impact on liberalization on other, non-aggregated groups, is not clear at this level.

By extending the model to examine the table quality group, imported beef is a substitute for domestic beef, (0.1520), but at a lower level than suggested in the aggregation model. This may reflect the closer meat items, and hence, the success of the Japanese government to maintain domestic prices for domestic beef in this model.

The differences in country of origin reflect a possible shift from Australian grassfed beef to US grainfed beef (Table IV.2, page 41).

This is suggested by the differences in sign in the cross price elasticities of Australian and US beef. Australian beef is considered a weak complement of US beef (-0.0319), while US beef is a substitute for Australian beef (0.2236). This shift in market share may be due to the use of the High Quality Beef Quota, rather than a shift in the demand for grassfed or grainfed beef.

Imported beef elasticities disaggregated by origin were reported in Lin, et al. They reported that all imported beef groups were substitutes of other the imported beef items. Each country had a different own price elasticity, ranging from -0.149 for Australian beef, to -1.812 for New Zealand beef. The income elasticity of the aggregated imported beef was estimated to be 1.9, suggesting that imported beef is a luxury good. This values greatly differ from the values reported here. The reported income elasticity from this study was 3.274.

Imported beef has not been compared to imported edible offal in other studies. But, when compared in the table quality model, the two meats are clearly substitutes. Thus liberalization could increase beef imports but decrease edible offal imports, which are considered a by-product of domestic meat production. The other meat sub-group and the table quality sub-group supports the importance of imported edible offal to satisfy the Japanese demand for beef.

Imported edible offal is also a substitute of pork and imported processing meats (horsemeat and lamb and mutton). The liberalization of the Japanese market may lead to a decrease in the absolute level of imported pork (a substitute of both imported beef and imported edible offal) and imported processing meats (by extending the argument that imported edible offal is a substitute for imported horsemeat and imported sheepmeat). Liberalization would possibly lower per capita consumption of these meats at the expense of foreign producers. Imported edible offal however is a substitute of imported processing meats.

Imported processing meats, horsemeat and sheepmeat, were mostly inferior goods, and were complements of most other meats in the model. Coyle (1983a) reported several estimated elasticities of different meat groups in Japan. These studies all reported these meats as a normal goods and complements of the other meats in the Japanese diet. Further, Coyle reported elasticities of other meats, mainly imported lower quality processing meats. These meats all were considered to be normal goods but were very price elastic.

The role of fish in Japanese consumption is clearly indicated by the price elasticities. When aggregated fish consumption is estimated and compared to other aggregated meat groups, fish is viewed as a complement of both dairy and imported beef. However, in the quality model, the estimated elasticities of the different fish groups indicates that fish does compete with the other meat groups, and that the inclusion of an aggregated fish group may lead to misspecification, similar to the domestic beef grades discussed earlier.

CONCLUSIONS

In examining Japanese meat demand, quality does influence domestic consumption. The level of disaggregation reflects the level of quality.

The failure of aggregated models to fully capture the quality differences of the various meats indicates that aggregation may lead to biases. However, when using disaggregated data, different problems arise. These problems mainly are multicollinearity and the availability of data.

Multicollinearity presents a problem as the different levels of meats are related in different ways at different levels. Disaggregation of meats that are produced in a similar manner and marketed in the same channels will respond to the same basic price changes. This would lead to the possibility of multicollinearity. However, if disaggregation was between meats that did not experience similar production or marketing channels, then multicollinearity may present less of a problem.

In this study, multicollinearity was a problem. Miyazaki discussed how the Japanese producer finishes his cattle at a relatively high weight in anticipation of receiving a more marbled carcass, which would result in a higher grade. The bulk of this additional feeding is undesired fat which must be trimmed away rather than the desired marbling. This indicates that the Japanese producer may respond to the prices of a grade different from the actual grade of the animal that is being fed.

The data used in disaggregated studies also presents a problem. The availability of grade prices and quantities limited the study to 1984. But, disaggregation was also based on aggregation of certain meat groups, such as pork, chicken, and imported meat items (beef, horsemeat, edible offal, and sheepmeat). The only disaggregation was between the various beef grades and the fish quality goods. This type of disaggregation may either not be a concern or readily accessible to other researchers, especially due to the timely nature of liberalization studies. The level of disaggregation used depends upon the emphasis of the study. In this study, the emphasis was placed upon the various grades of domestic beef (Wagyu and dairy) and their relationship to other meats.

SUGGESTED RESEARCH

As the Japanese market becomes more liberalized, it is more possible for some type of response to occur in consumption due to price changes. These two models are built to provide a framework for estimating changes due to liberalization in such a manner as to better reflect Japanese consumption patterns. The market structure may be altered due to liberalization, and as such the model above would hopefully point out possible conflicts and more clearly indicate those items most likely affected by liberalization.

These models did not examine the differences in product form. Some different product forms include a comparison of aged beef exports to frozen or chilled beef exports, or boxed cuts versus whole carcasses. Other possible studies may include the examination of the differences on a retail level in marbling and cut between imported beef and other meat groups. Another possible study is the associated impacts of the removal of the LIPC upon price variability and marketing channels.

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VITA

Bruce Lambert was born in Bryan, Texas on January 6, 1965. He attended elementary schools in both Broussard and Lafayette, Louisiana. After graduating from Ovey Comeaux High School in May, 1983, he was then enrolled at Louisiana State University in Baton Rouge. In May, 1987, he was awarded a Bachelor of Science in Agricultural Economics. In September, 1987, he accepted a research assistantship at The University of Tennessee, Knoxville, and began study towards a Master of Science degree. He received his degree in May, 1990.

The author is a member of the American Agricultural Economics Association, Alpha Gamma Rho, Alpha Zeta, and Omicron Delta Kappa. At the time of this writing, the author was the Sheltering Operations Manager at the Knox County Humane Society.