AN ABSTRACT OF THE THESIS OF

Akihiro Kikuchi for the degree of Master of Science in Agricultural and Resource Economics presented on March 12, 1987.

Title: Salmon Consumption at the Household Level in Japan

Abstract approved: ______________________________

Richard S. Johnston

The primary purpose of this study is to investigate the salmon demand of Japanese households. The specific goals are to illuminate the substitutional relationship between salmon and other foods and to examine seasonal and regional differences in salmon demand.

To analyze substitutional relationships and seasonal differences, monthly data on consumption by Japanese households are used. An econometric model was developed in which salmon demand was specified with quantity of salmon consumed as the dependent variable and income (food expenditure), price of salmon and the price of possible substitute commodities as independent variables. To investigate the regional differences, five geographically different regions were selected. Analysis was conducted with annual data.

Among the findings are that pork may be a substitute commodity for salmon in Japanese households, and that there are clear seasonal and regional differences in terms of salmon demand at the household level in Japan.

Salmon Consumption at the Household Level in Japan

by

Akihiro Kikuchi

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed March 12, 1987

Commencement June 1987

APPROVED:

Professor of Agricultural and Resource Economics in charge of major

Head of Department of Agricultural and Resource Economics

Dean of Graduate School

Date thesis is presented March 12, 1987

Typed by Mary Brock for Akihiro Kikuchi

ACKNOWLEDGEMENTS

I am most appreciative of the following for their roles in the preparation of this thesis and their support during my graduate studies at Oregon State University.

Dr. Richard S. Johnston, major professor, who gave freely of his expertise and kindness. His optimism and assurance were of significant influence and made learning a pleasure.

Dr. R. Bruce Rettig and Dr. Susan S. Hanna, graduate advisory committee members, whose valuable criticism and advice were very helpful.

Dr. David R. Thomas, minor professor, whose statistical comments proved beneficial.

Ms. Mary Brock for putting this manuscript in thesis form.

Mr. Terry Sinclair for English assistance. His help was invaluable.

Sea Grant, for financial support in the form of a graduate research assistantship.

I also wish to express my sincere appreciation to Dr. Akira Hasegawa, professor of Tokyo University of Fisheries. His continuous encouragement while I have been in the United States led to this accomplishment.

TABLE OF CONTENTS

		Page
I.	INTRODUCTION AND PROBLEM STATEMENT	1
II.	SEAFOOD CONSUMPTION IN JAPAN	3
III.	JAPANESE SALMON CONSUMPTION	6
IV.	SUPPLY OF SALMON IN JAPAN	16
V.	EXPANSION OF THE UTILITY OF LOW QUALITY SALMON	23
VI.	ANALYSIS OF SALMON DEMAND IN JAPAN	26
	The Setting	26
	Substitutes for Salmon	26
	Seasonal and Regional Patterns	27
	The Model	29
	Substitutional Relationships	30
	Seasonal Patterns	31
	Regional Patterns	31
VII.	ECONOMETRIC ANALYSIS	33
VIII.	CONCLUSIONS AND RECOMMENDATIONS	42
	Conclusions	42
	Suggestions for Further Research	43
BIBLIOGRAPHY		45
APPENDIX:	DATA USED IN THE ANALYSIS	47

LIST OF FIGURES

Figure		Page
1	Rice (non-glutinous) Consumption in Japan by Age Groups of Household Head: 1981-1985, annual average . .	7
2	Real Value of Japan's Exports of Canned Salmon: 1967-1983	10
3	Quantity of Salted Salmon Consumption at the Household Level in Japan: 1965-1985 (per year per capita)	11
4	Expenditure on Salted Salmon at the Household Level in Japan: 1965-1985 (real value, 1980=100, per year per capita)	12
5	Household Consumption of Seafood and Meat in Japan: 1965-1985 (per year per capita)	13
6	Retail Price of Fresh and Salted Seafood and Salted Salmon in Japan: 1965-1985	15
7	Landings of Coastal Salmon in the Set Net Fishery of Hokkaido	20
8	Map of Japan for Geographical Distinction	28

LIST OF TABLES

Table		Page
1	Household Consumption of Fresh and Salted Seafood and Meats in Japan: 1981-1985 Average Quantities and Expenditures (per year per household)	4
2	Salmon Supply in Japan by Fishery Type and Export and Import	9
3	Salmon Fishing Quota for Japan by the U.S.S.R. in the North Pacific	17
A-1	Monthly Data	48
A-2	Annual Data by Region	49

SALMON CONSUMPTION AT THE HOUSEHOLD LEVEL IN JAPAN

I. INTRODUCTION AND PROBLEM STATEMENT

Japan, which consists of four main islands, is surrounded by the ocean. Therefore, seafood has traditionally been one of Japan's most important food commodities. Japanese people were prohibited from eating red meat until the middle of the nineteenth century when Commodore Matthew Perry arrived in Japan carrying a letter from the U.S. government insisting that Japan open trade with western countries. Prior to this event, seafood was an essential source of protein in the Japanese diet. Presently, the consumption volume of livestock is quite large, but the importance of seafood still remains.

After many countries extended their fishing zone to 200 miles in 1977, Japanese vessels have been facing increasingly adverse fishing conditions. In order to compensate for the reduction of catches which used to be fished within the extended fishing zones of other nations, Japan's seafood imports have increased rapidly.

In 1985, Japan imported salmon valued at 116,606 million yen (U.S. $730 million) and salmon roe valued at 19,035 million yen (U.S. $120 million).[1] Approximately 90% of these salmon imports come from the United States. United States exports of salmon and salmon roe accounted for 61.4% of total U.S. seafood exports to Japan (1983 data). The salmon industry is an important fishing industry in the

---

[1]C.I.F. price basis; exchange rate, U.S. $1.00=160 yen.

United States and salmon trade will continue to keep its importance in terms of seafood business between the U.S. and Japan.

In the present study, Japanese salmon consumption at the household level is investigated. A better understanding of factors affecting Japanese consumption may be useful to Americans who are involved in Japan's seafood market. Also, this study may help the understanding of persons who are interested in Japanese food habits through the analysis of one of the most popular seafoods in Japan, namely, salmon.

Study objectives are the following:

- To survey the form of salmon consumption in Japanese households.

- To investigate the supply aspect of salmon in Japan.

- To discuss a recent problem in the Japanese salmon market and its possible solution.

- To estimate substitutional relationships between salmon and other foods.

- To test to see if the demand for salmon differs among seasons.

- To examine regional differences in salmon demand.

II. SEAFOOD CONSUMPTION IN JAPAN

The Japanese use many kinds of seafood and make various types of seafood dishes. Among the typical Japanese-prepared forms of seafood are sashimi (raw), nizakana (short boiling with soy sauce), yakizakana (broiled or grilled) and sunomono (raw seafood immersed in vinegar).

As Table 1 shows, between 1981 and 1985, the Japanese consumed 67.6 kg of seafood per household, on average, per year.[2] On the other hand, they consumed 19.1 kg, 14.4 kg and 9.8 kg of pork, chicken and beef, respectively. Total consumption of pork, chicken and beef is less than seafood consumption with respect to both quantity and expenditure.

In their households, they consume many species of seafood. This is a noticeable characteristic of the food habits of the Japanese people. Species which individually account for less than 1% of the total quantity of seafood consumption together make up 41.4% of the total (Table 1).

Another characteristic of Japanese dining is that their cooking reflects the seasons. The most suitable seafood choices correspond to the fishing seasons. For example, Japanese household consumption of saury is concentrated in the fall. This is because the saury which migrate off Japan's shore in this season contain rich fat.

---

[2]This is the total of fresh and salted seafood. Canned and processed products like kamaboko are not included.

Table 1. Household Consumption of Fresh and Salted Seafood and Meats in Japan: 1981-1985 Average Quantities and Expenditures (per year per household)

	Quantity		Value		Price
	%	g	%	yen	yen/100g
Squid	9.2	6,195	6.8	6,870	112
Salmon	7.5	5,084	9.1	9,260	182
Horse Mackerel	5.4	3,668	4.5	4,547	124
Sardine	5.0	3,377	1.8	1,860	55
Tuna	4.6	3,091	8.2	8,329	269
Flounder	3.9	2,655	3.4	3,448	130
Shrimp and Prawn	3.8	2,543	6.6	6,733	265
Saury	3.4	2,311	1.8	1,834	79
Yellowtail	3.3	2,263	5.0	5,017	222
Mackerel	3.2	2,153	1.2	1,202	56
Bonito	2.0	1,354	2.1	2,175	161
Octopus	1.9	1,289	1.9	1,883	146
Salted Cod Roe	1.5	1,041	3.2	3,275	315
Sea Bream	1.5	993	2.3	2,340	236
Crab	1.3	873	1.7	1,719	197
Cod	1.1	758	0.5	545	72
Other Seafood (each species accounts for < 1%)	41.4	27,961	39.7	40,214	144
Seafood Total	100.0	67,609	100.0	101,251	150
Pork (a)		19,181		28,823	150
Chicken (b)		14,415		14,679	102
Beef (c)		9,764		30,653	314
(a) + (b) + (c)		43,360		74,155	

Source: Statistics Bureau, Management and Coordination Agency, Japan

Also, bonito harvested in early summer is highly valued because of its superior taste.

III. JAPANESE SALMON CONSUMPTION

Among the many seafood commodities consumed in Japanese households, salmon is one of the most popular. Even in early times when cold storage systems were not well developed, salmon could be preserved for relatively long periods by salting it. For this reason, salmon is valued very highly by the Japanese. As Table 1 shows, salmon is still a highly valuable commodity for the Japanese. They consume about 5 kg yearly per household, which accounts for 7.5% of all seafood consumption, and spend 9,260 yen yearly per household, which accounts for 9.1% of all expenditures for seafood consumption. This expenditure is the largest of the seafood species categories.

The standard form of a Japanese meal is the combination of plain rice and a side dish. Nowadays, the Japanese meal patterns are being westernized. The consumption of rice is decreasing and is being replaced by breads and pasta. The diet of older people, however, still consists mainly of rice and an entree (Figure 1). A meal of salted, baked salmon and plain rice is one of the most popular choices for breakfast and occasionally for lunch.

At the retail store, salmon is usually purchased in a salted fillet form by consumers. Salted salmon fillets are preserved and last longer than fresh seafood, thus eliminating the need to cook the salmon on the day of purchase. This is the reason that most salmon is sold in the salted fillet form in Japan. Salmon fillets are simple to cook. Most often they are just baked and served with rice. Unlike the cooking of other seafood, there is not much waste, like

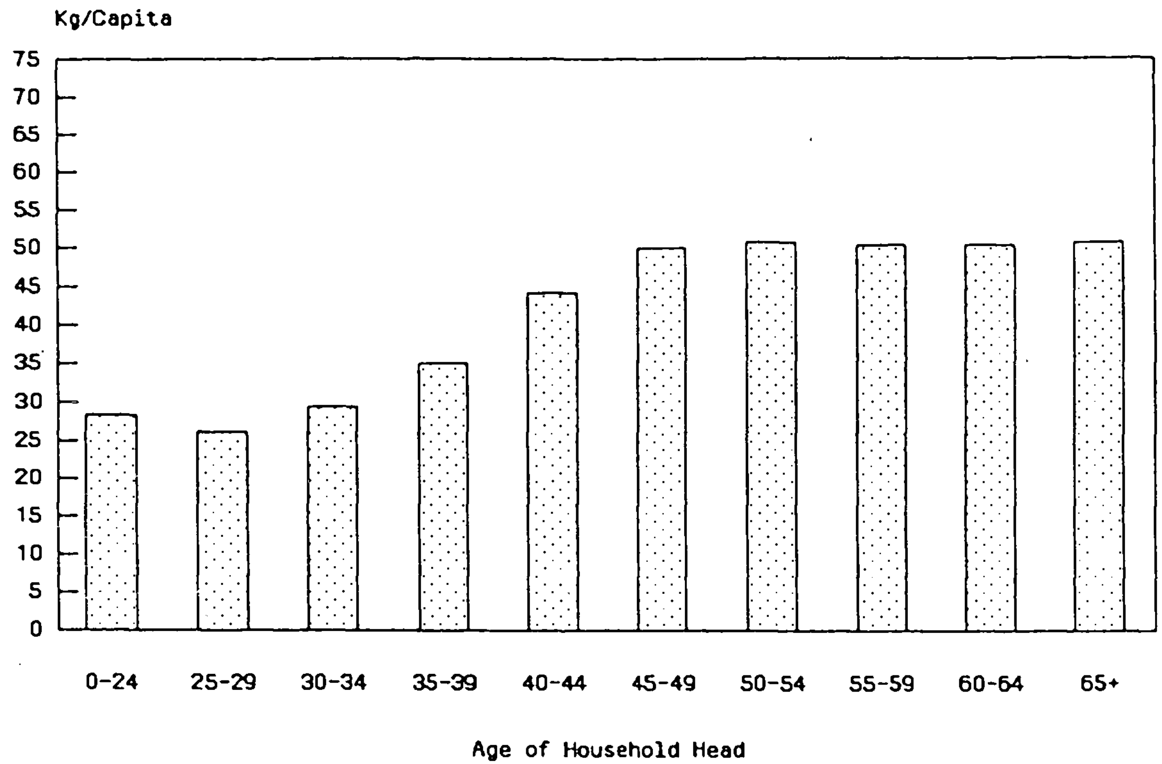

Figure 1. Rice (non-glutinous) Consumption in Japan by Age Groups of Household Head: 1981-1985, annual average

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan

skin or bones, to deal with. The ease of cooking is one reason salmon is still popular in Japanese households. As women start to enter the workforce, complicated seafood cooking is losing popularity.

In Japan, most salmon is consumed in fillet form; the consumption of canned salmon is relatively small. Since 1978, the annual canned salmon production has been less than 10 thousand metric tons. In comparison with the total salmon supply in Japan, which has averaged more than 200 thousand metric tons annually since 1981 (Table 2), the percentage of canned salmon products consumed is very small, unlike the United States. Canned salmon used to be a major export commodity of the seafood industry. However, since expanding its fishing zone to 200 miles in 1977, the U.S.S.R. has been reducing the salmon quotas of Japanese vessels in the North Pacific Ocean. Due to quota cuts, the importance of canned salmon exportation has been lost (Figure 2).

There are several other product forms of salmon besides the fillet or canned form. For instance, salmon may be in a flaked or ground form. Presently these products are not very popular. As the domestic salmon harvest increases, the problem of excess supply appears. Therefore, the development of these new forms of salmon is being discussed.

Figures 3 and 4 show the quantity and expenditure on salmon by Japanese households in the past two decades. As the Japanese economy has grown since the 1960s, so has the consumption of salmon. As shown in Figure 5, in the past two decades the total seafood

Table 2. Salmon Supply in Japan by Fishery Type and Export and Import

	North Pacific Fishery															
	Mothership		Drift Gill Net		Coastal Set Net		Others		Total (A)		Export (Canned) (B)		Import (C)		Grand Total (A-B+C)	
	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT	Index 1975=100	Thousand MT
1970	107	36.4	82	45.6	34	21.0	210	14.9	74	117.9	136	24.0	76	5.2	67	99.1
1975	100	33.9	100	55.7	100	62.6	100	7.1	100	159.3	100	17.7	100	6.8	100	148.8
1977	70	23.6	69	38.4	77	48.4	86	6.1	73	116.5	24	4.2	283	19.3	88	131.6
1978	45	15.4	45	25.3	91	57.2	70	5.0	65	102.8	22	4.0	730	49.8	100	148.6
1979	45	15.4	47	26.1	133	83.5	85	6.0	82	131.0	1	.2	802	54.7	125	185.5
1980	45	15.4	47	26.1	119	74.4	93	6.6	77	122.5	.7	.1	577	39.3	109	161.7
1981	45	15.4	47	26.0	162	101.4	100	7.1	94	149.8	7	1.3	1,053	71.8	148	220.3
1982	45	15.4	47	26.4	138	86.3	115	8.2	86	136.3	.6	.1	1,579	107.7	164	243.9
1983	45	15.4	47	26.1	176	110.0	134	9.5	101	161.0	.3	.05	1,454	99.2	175	260.2
1984	43	14.5	36	20.2	175	109.8	180	12.8	99	157.3	4	.7	1,366	93.2	168	249.8

Source: Gyogyo-Yoshokugyo Seisan Tokei Nenpo, Nihon Boueki Geppyo

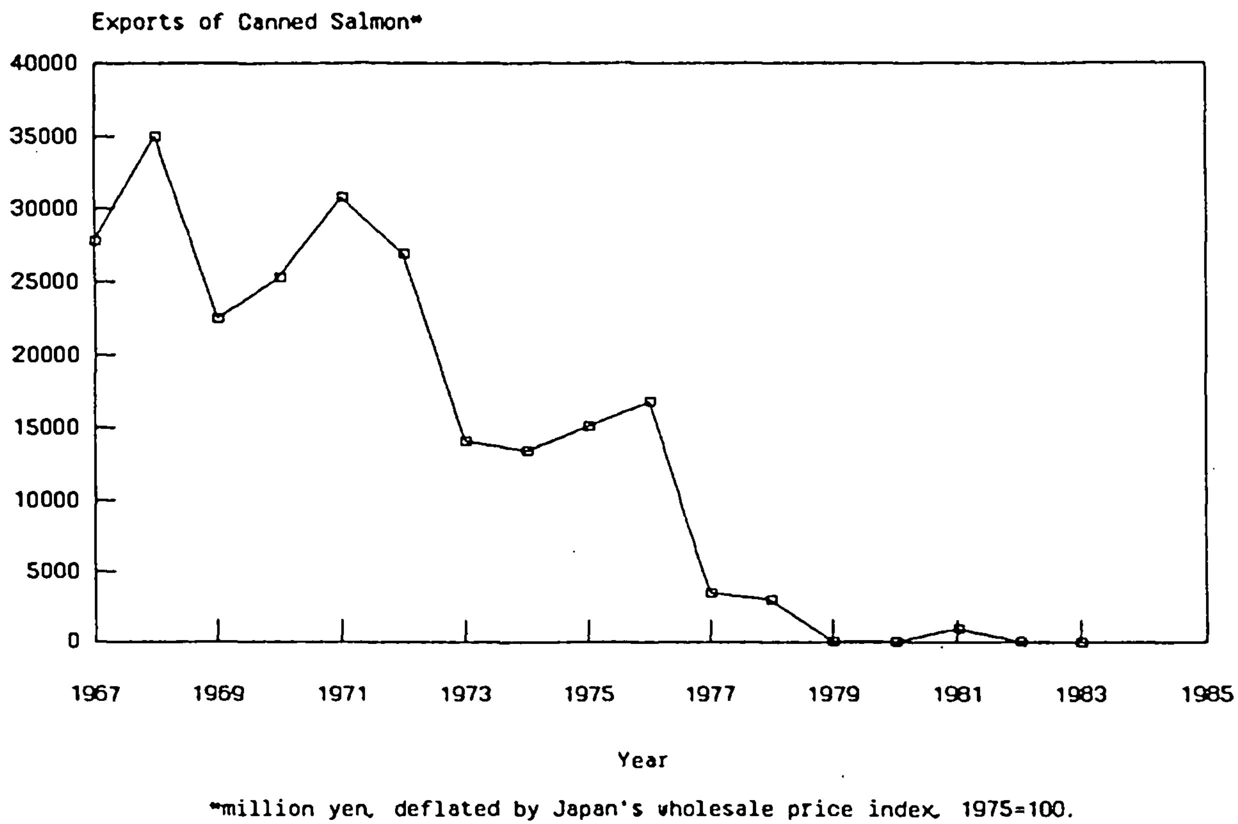

Figure 2. Real Value of Japan's Exports of Canned Salmon: 1967-1983

Source: Ministry of Agriculture, Forestry and Fisheries, Fisheries Statistics of Japan, various issues; Organization for Economic Co-operation and Development, Review of Fisheries in OECD Member Countries, various issues

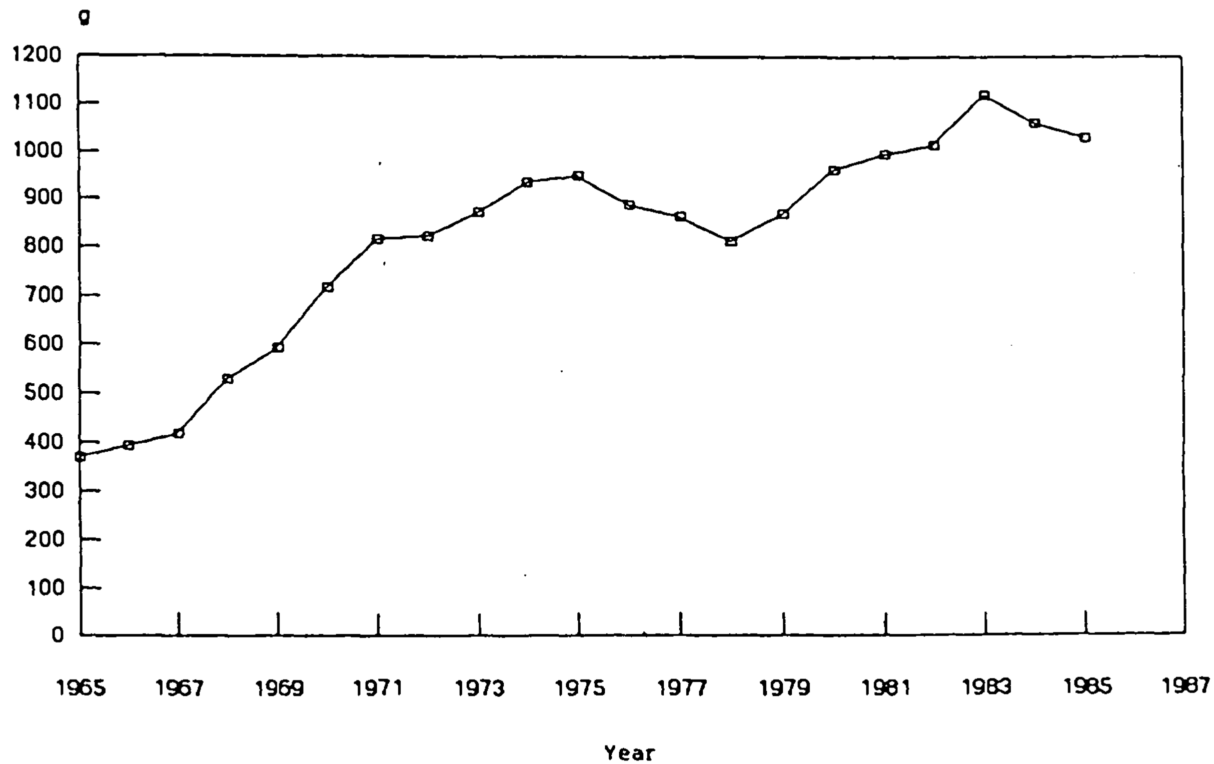

Figure 3. Quantity of Salted Salmon Consumption at the Household Level in Japan: 1965-1985 (per year per capita)

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan

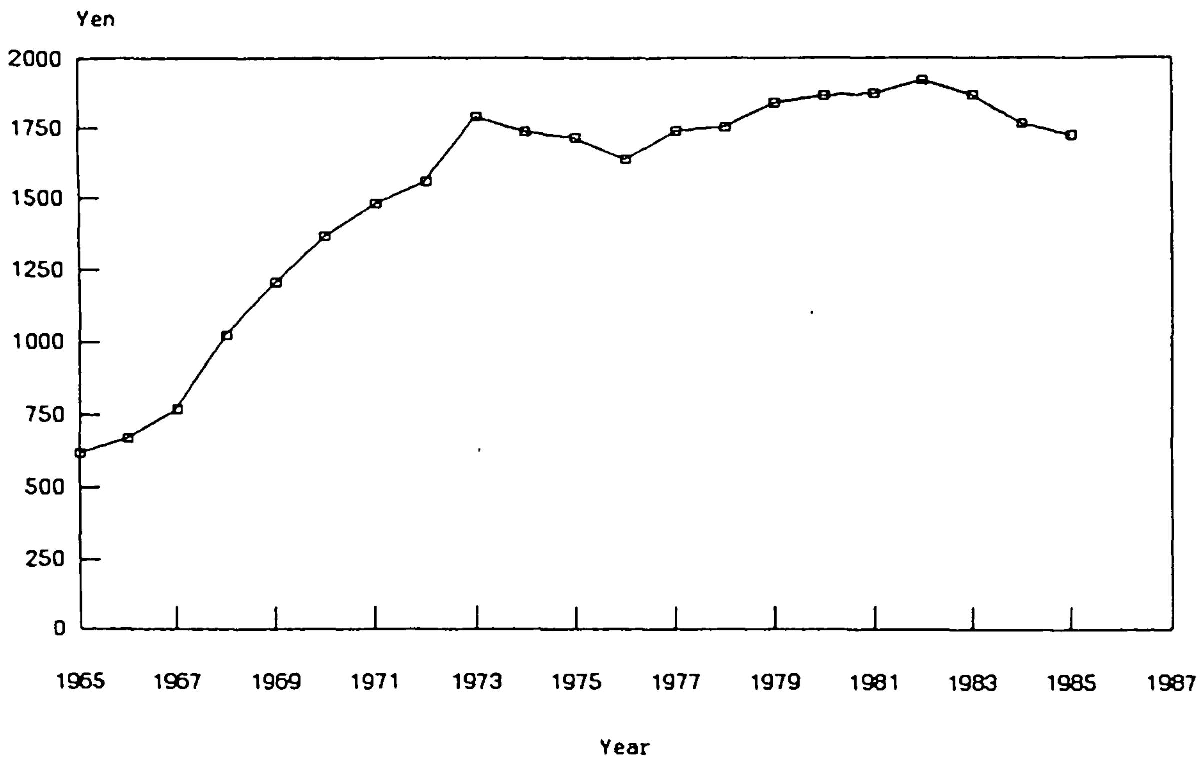

Figure 4. Expenditure on Salted Salmon at the Household Level in Japan: 1965-1985 (real value, 1980=100, per year per capita)

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan

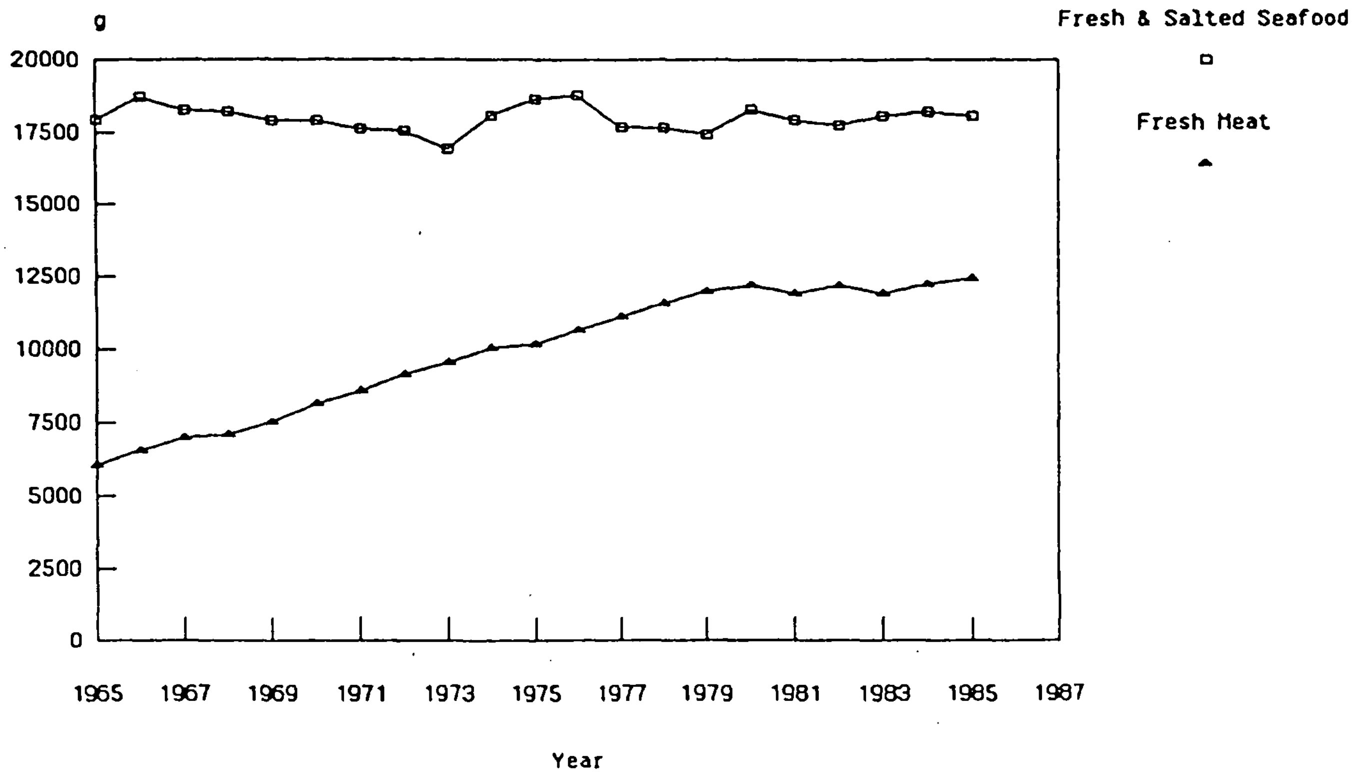

Figure 5. Household Consumption of Seafood and Meat in Japan: 1965-1985 (per year per capita)

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan

consumption has been quite stable; the consumption of meat, however, has increased substantially.

Figure 6 shows that real seafood prices increased approximately 150% in the past two decades. Although there have been several fluctuations in salmon prices over that period, due to the first oil crisis and extended fisheries jurisdiction, the real price of salmon in the last few years is not much different from the prices of twenty years ago. Nonetheless the expenditure and quantity of salmon consumption in Japanese households tripled during the past two decades. This indicates that salmon has desirable characteristics for modern Japanese households. Unlike some other seafood, the cooking of salmon is not complicated and there is little waste after cooking. These characteristics of salmon are important to the modern Japanese housekeepers.

With respect to these Japanese preferences, meat products are considered by the modern Japanese household to have favorable characteristics. Also, the younger generation prefers a westernized meal and this has led to the continuous increase in meat consumption. These factors may lead to the substitution of meat for seafood. The impact does not appear to have been as severe for salmon as for other seafoods. As shown in Figure 4, expenditures on salmon in Japanese households started to decline after the oil crisis in 1973. Later the expenditures began to increase again though. Since 1978, changes have been relatively small, although consumption has declined since 1982.

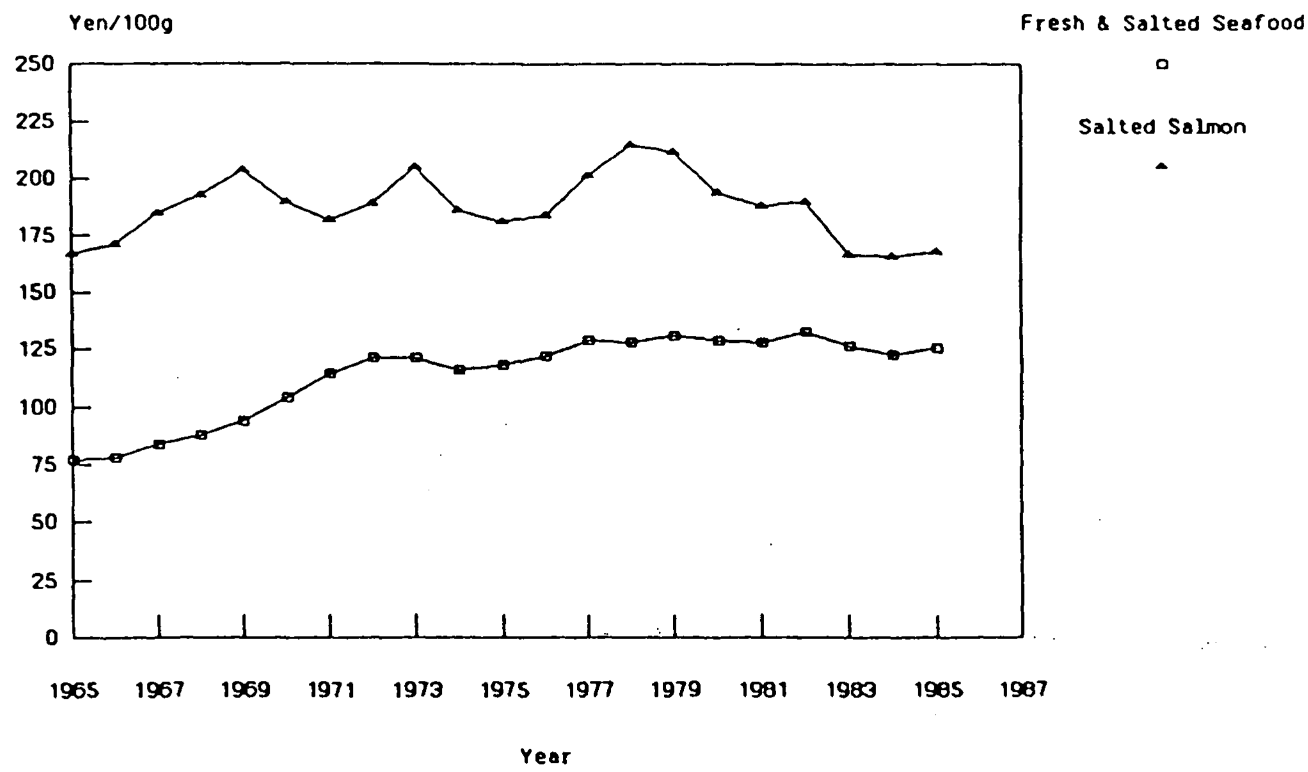

Figure 6. Retail Price of Fresh and Salted Seafood and Salted Salmon in Japan: 1965-1985

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan

IV. SUPPLY OF SALMON IN JAPAN

There are three sources of salmon supply in Japan: 1) the pelagic fishing in the North Pacific, 2) imports, and 3) coastal set net fishing. Table 2 shows the supply from each channel. In the past decade, both landings from the North Pacific fishery and exports have been decreasing, while coastal set net fishing and imports have been increasing.

The fishing quota that the U.S.S.R. allows Japanese vessels in the North Pacific Ocean is shown in Table 3. The decrease in the catch from the North Pacific is a reflection of these reductions in the quota. The tendencies of the U.S.S.R. to lower the salmon quota of Japanese vessels and of the U.S. and Canada to restrict Japanese harvests are becoming more severe each year. This was especially true in 1986. The quota for that year was lowered by 35% from the previous year's level. The impact of the cut in the 1986 quota was a serious shock to related industries. The U.S.S.R. and the United States have insisted on the withdrawal of Japanese fishing vessels from the North Pacific; therefore, it is expected that the supply from this channel will continue to decrease.

The salmon fishing season in the North Pacific is from May to July. There are two types of North Pacific fishing: mothership fishing and drift gill net fishing. Each type of fishing is assigned its own catch quota and fishing ground. The salmon harvested by mothership fishing is frozen and kept in the ship. Salmon used to be

Table 3. Salmon Fishing Quota for Japan by the U.S.S.R. in the North Pacific

Year	Metric tons
1970	90,000
1976	80,000
1977	62,000
1978	42,500
1979	42,500
1980	42,500
1981	42,500
1982	42,500
1983	42,500
1984	40,000
1985	37,600
1986	24,500

Source: Hokkaido Suisanka

canned on board the mothership during the period, but this practice was discontinued after 1977.

The species harvested in the North Pacific fishery are pink, chum,[3] coho, sockeye, and chinook salmon. These salmon contain more fat than the salmon that are caught in the coastal set net fishery in the fall. Since the Japanese prefer fattier fish, the salmon from the North Pacific are highly valued. Also, the salmon that have red muscles, like the sockeye and the coho salmon, can get a higher price in the Japanese market. People prefer the red coloration because of its visual appeal.

Japanese imports of salmon increased rapidly after the 200 mile exclusive economic zone declarations in 1977 (Table 2). Most salmon are imported between July and October, with especially big imports in August. More than 90% of imported salmon is from the United States; thus these import months correspond to the fishing season in Alaska. Imports have been increasing as the Japanese catch from the North Pacific decreases. The main species imported is the sockeye salmon which is not harvested in the coastal set net fishery. In 1985, the amount of imported salmon reached 116,000 metric tons. As a result, in 1986, excessive inventories caused prices to decrease dramatically.

Fresh salmon have been imported from Norway recently. Although only 34 metric tons of Norwegian fresh salmon were imported in 1982,

---

[3]The chum salmon harvested in the North Pacific is called "toki-sake" to distinguish it from the chum salmon caught in the coastal set net fishery in the fall.

the figure was 2,819 metric tons in 1985. The Norwegian fresh salmon exports to Japan have been constantly increasing and have accounted for 13% of Norway's 1985 fresh salmon exports (B.C. Ministry of Agriculture and Food).[4]

The fishing season in the coastal set net fishery is from September to December. In this fishery, salmon are harvested as they return to spawn in the river where they were born. The species caught is mostly chum salmon (aki-sake).[5] These returning salmon contain less fat in comparison with salmon harvested in the North Pacific, but they have mature roe. The salmon roe is a highly valued commodity in the Japanese market. This is one advantage of the aki-sake.

As Table 2 and Figure 7 show, landings from coastal fishing have been increasing. This is the result of the releasing of baby salmon under a program sponsored by the Japanese government. Recently, the rate of salmon returning to spawn has reached about 3%, as compared to only 1% in the 1950s. With this success, salmon set net fishing has become one of the most stable and profitable fishing businesses in Japan. In 1986 there were 827 fishing units in the coastal salmon set net fishery and about 8,300 fishermen employed in Hokkaido.

---

[4]The production of domestically farmed coho salmon began in 1980 on an entrepreneurial basis. Japanese farm-grown salmon may be considered as a competitive commodity with fresh salmon from Norway. Production has been increasing and in 1985 reached 6,800 metric tons.

[5]The chum salmon caught by this method are called "aki-sake," which means fall-salmon, to distinguish them from the toki-sake.

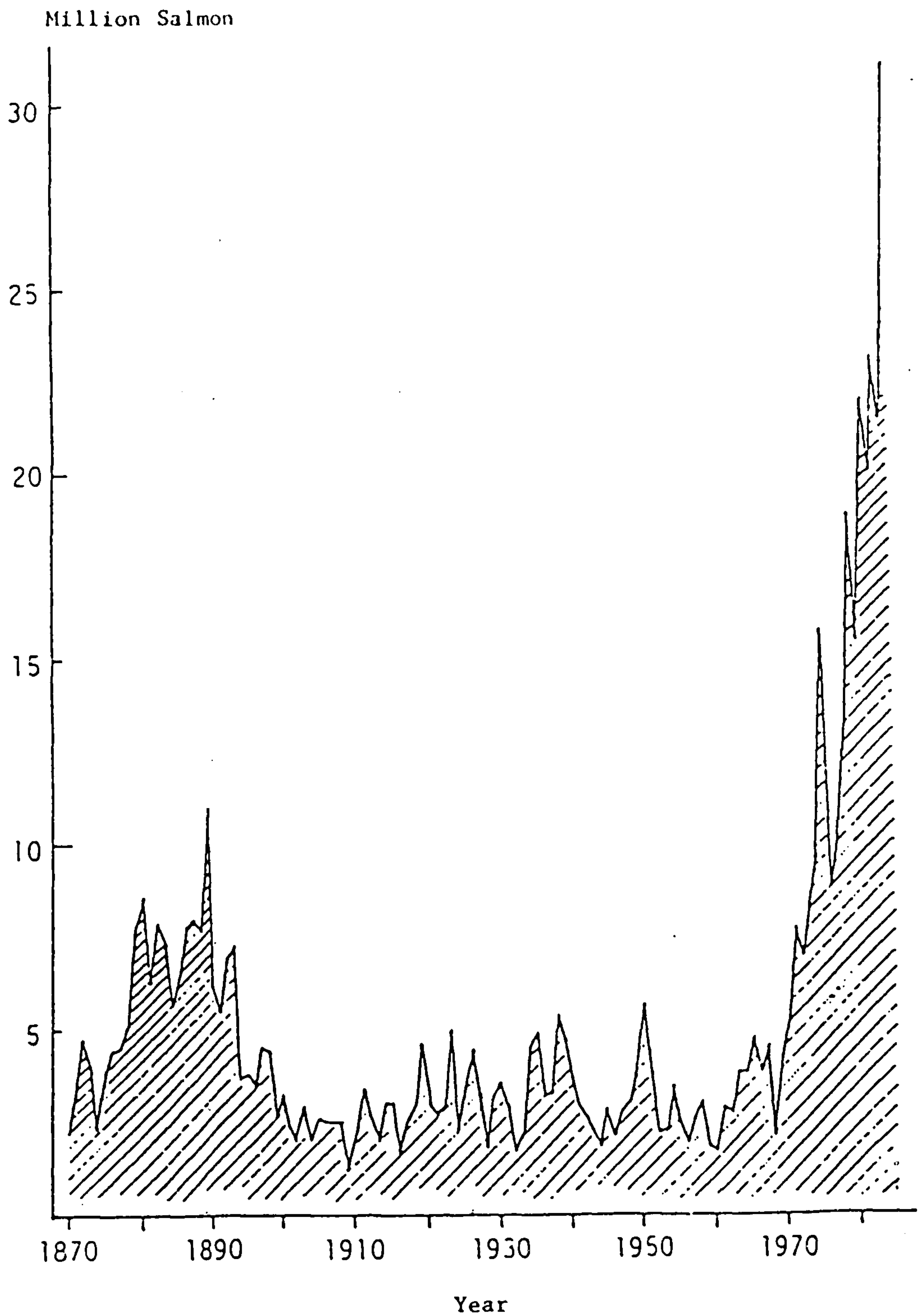

Figure 7. Landings of Coastal Salmon in the Set Net Fishery of Hokkaido

Source: Hokkaido Sake-Masu Fukajou, Kobayashi

One problem has appeared with the rapid growth of this fishery. Coastal set net fishing harvests the fish that are coming back to spawn. As the day of spawning comes closer, the body of the salmon becomes more mature, resulting in a poorer quality of the meat as seafood. The muscle contains less fat and the color of the muscle becomes pale.

Returning salmon are categorized by quality into three types, mejika, ginke and buna. Mejika are the salmon caught more than 40 days prior to the expected spawning day. This salmon contains about 6% fat in its muscle. Ginke is the salmon caught more than 25 but less than 40 days prior to the spawning day, and contains about 4% fat. The fish which are caught less than 25 days before spawning are called buna.[6] Among these three categories of salmon, mejika, which are the best quality and least mature, are very few. Most of the salmon taken in the coastal fishery are ginke and buna. In the Hokkaido catch roughly 60% of the salmon are ginke and 40% are buna; in Sanriku, 30% are ginke and 70% are buna.

The quality of about half of the buna salmon is not high enough for the fillet market. In the past when the coastal salmon catch was smaller, low quality buna salmon fillets would sell at a lower market price than ginke, after the supply of ginke was depleted. Nowadays, since the amount of both ginke and buna have increased as the result of coastal fishing success, it is difficult to sell the lower quality buna in the fillet form.

---

[6] In comparison with these salmon, toki-sake contains approximately 8% or more fat in its muscle.

To try to increase the supply of returning ginke salmon the government salmon hatchery incubates the ginke salmon roe. Researchers hope that these hatched salmon will return early (while still of ginke quality) as their parents did. This is not a sure way to solve the problem though. Therefore, it is expected that other marketable forms of buna instead of the fillet form will be developed. New trial processes are now proceeding.

V. EXPANSION OF THE UTILITY OF LOW QUALITY SALMON

As a result of the rapid increase of imports and the growth of the coastal fishing, as Table 2 shows, the supply of salmon in Japan recently reached approximately 250,000 metric tons. This is about a 100,000 metric ton increase from 1975. This large increase in the total salmon supply has caused problems in buna salmon utilization, as just discussed.

There are several marketable forms for the buna salmon that cannot be processed into fillets. These include processed frozen fillets for deep fried cooking (which covers up the inferior characteristics of lack of fat and color), ground products for salmon hamburger, and flaked salmon which is a complement for plain rice. These products are relatively cheap and are preferred by volume purchasers, like the away-from-home eating industry. Recently the lunch box industry,[7] which is managed like a chain store system, has grown successfully, with salmon being one of the most popular items. These items are served with rice, like the salmon fillet dishes.

Most seafood is usually, in fact, served with rice. According to the research by Hiroyuki Toyokawa, people who consume more rice, consume more seafood. He indicated that there is a positive correlation between rice and seafood consumption, while there is a

---

[7]Each retail store fixes each order ("lunch box") in its own cooking facilities and usually does not have eating space. The price of one portion is about between U.S. 2 and 4 dollars. This product appeals to a wide range of customers: college students, workers and housekeepers, etc.

negative correlation between consumption of wheat products (bread, pasta) and seafood consumption.

Nowadays, as the Japanese food habits have become more westernized, the consumption of rice has decreased and the supply of rice is in excess. In order to address this situation, the Japanese government has proceeded with a new policy that would encourage the substitution of rice for breads in the school-kyushoku program.[8]

Until recently, bread was a major part of the school-kyushoku program, unlike the ordinary Japanese meal, because of the convenience of preparation and serving. Because the volume of the school-kyushoku is very large, as rice becomes more dominant than bread in the program, the consumption of seafood, which is a complement for rice, is expected to increase as well. Also, in accordance with the recently revised school-kyushoku nutritional criteria, requiring a lower calorie intake, people are urged to use seafood more often. For these reasons, in the near future, seafood will appear more often in school-kyushoku menus.

For seafood to increase in the school-kyushoku program, several factors have to be satisfied first. One of them is a more competitive price in comparison with other meat, especially pork and chicken. Another one is stability of supply because of the large,

---

[8]School-kyushoku is the popular lunch system widely operated in most elementary and junior high schools. Food is cooked in a centralized kitchen and all students eat the same kyushoku (literally "provide food") lunch in their classroom with their teacher. The nutritionists determine the whole menu and usually there is not an option in the menu. Each regional board of education designs suitable programs fitted to their area.

continuous consumption of the school-kyushoku program. This is sometimes considered a disadvantage in using seafood as a school-kyushoku menu item. Most seafood is harvested in a specific season and the quantity of the harvest may vary in each year and price is likely to change in response to supply.

Unlike most of the seafood which have these disadvantages, buna salmon satisfies both needs of the school-kyushoku program: the stable landing of returning salmon each year and a cheap price. It can also be preserved for long periods through freezing. Buna salmon appear to have great potential in the school-kyushoku due to their stable supply, price and preservability.

VI. ANALYSIS OF SALMON DEMAND IN JAPAN

The Setting

As discussed earlier, the objectives of this research include estimates of substitutional, seasonal and regional factors in the demand for salmon by Japanese households. These issues have been studied by other researchers and are discussed below.

Substitutes for Salmon

In a 1985 study of the impact of imports on wholesale salmon prices in Japan, Asada found inventory levels, total salmon supply, the share of imports in supply, import price, exchange rate, and real prices of meat to be important factors in the determination of salmon prices. According to his empirical work, the influence of prices of other seafoods is not apparent. He found that "the influence of seafood price is relatively small. In the trials, adding the seafood factor did not contribute to the statistical results" (approximate translation). Asada used annual data for the 1973-1984 period in his econometric analysis.

Taya reached similar conclusions. He found that salmon can influence other seafoods but that prices of other seafoods do not influence salmon consumption. He further found, however, that squid prices lead other seafood prices. Taya used monthly data on household consumption for 1975-1984. His regression models focused exclusively on price-quantity relationships.

Hirasawa uses price to group seafoods into three categories which can thus be related to beef, hog and chicken prices. He argues that high quality fish (high priced fish) are affected strongly by beef prices, weakly by hog prices, and not at all by chicken prices in Japan. Medium quality fish, including salmon, are affected primarily by hog prices, according to his classification scheme. The influence of prices of poultry and other meats is less strong.

Seasonal and Regional Patterns

Akitani examined seasonal consumption patterns in Japan. January consumption is lowest and this tendency continues until April. During May each year's harvest begins in the North Pacific and, thus, salmon consumption increases. It reaches a peak in July and August. In September, domestic set net fishing begins in Japan. After this month, the main salmon consumption is of chum salmon. In December, there is traditional consumption associated with the New Year celebration. December consumption is approximately 2.5 to 3.5 times that of other months.

The principal salmon landing ports are in Hokkaido (Figure 8). There is a long history of salmon harvest and consumption there. While large volumes of fish and shellfish are landed at other ports, salmon are not included. When transportation networks were not as extensive as they are today, seafood consumption patterns tended to build around those products available locally. These patterns exist to the present especially in rural areas, where traditional life styles and food habits remain. Salmon is not viewed as a high

Figure 8. Map of Japan for Geographical Distinction

quality fish and, thus, in these regions, even increases in income do not appear to generate increases in salmon consumption.

Climatic and cultural factors give rise to regional differences in tastes and preferences. Consider Kyushu and Shikoku, for example. Both are islands for which, until the 1960s, when economic conditions in Japan improved overall, transporting salmon from Hokkaido was uncommon. In addition, other seafood species are readily available there. Thus consumption patterns have evolved in these regions in which salmon do not play a major role, even in the presence of higher incomes and improved transportation networks.

Another factor may be related to species. Sockeye salmon tend to be preferred to chum salmon, largely because of flesh color and fat content. This is particularly true in Osaka, where consumers traditionally purchase more fancy food.

The Model

An econometric analysis of the household demand for salmon in Japan is used to explore these substitutional, seasonal, and regional issues. According to the Neoclassical framework, consumer demand satisfies the following conditions: (George and King, p. 10)

(a) The homogeneity condition:

$$\sum_j e_{ij} + e_{iy} = 0$$

(for i=1, $e_{11} + e_{12} + e_{13} + \ldots + e_{1n} + e_{1y} = 0$)

(b) The symmetry relation (Slutsky):

$$e_{ji} = e_{ij}(w_i/w_j) + w_i(e_{iy} - e_{jy})$$

(for j=3, i=2, $e_{32} = e_{23}(w_2/w_3) + w_2(e_{2y} - e_{3y})$)

Alternatively this can be expressed as $w_i e^*_{ij} = w_j e^*_{ji}$ where e^*_{ij} is the compensated cross price elasticity of demand for good i with respect to the price of good j.

(c) Engel Aggregation:

$$\sum_i w_i e_{iy} = 1$$

$$(w_1 e_{1y} + w_2 e_{2y} + w_3 e_{3y} + \ldots + w_n e_{ny} = 1)$$

(d) Cournot Aggregation:

$$\sum_i w_i e_{ij} = -w_j$$

(for j=3, $w_1 e_{13} + w_2 e_{23} + w_3 e_{33} + \ldots + w_n e_{n3} = -w_3$)

where e_{ij} represents the price elasticity of demand for the quantity of the i^{th} commodity dependent on the price of j^{th} commodity;

e_{iy} represents the income elasticity on the i^{th} commodity;

w_i represents the share of expenditures (budget proportions) on the i^{th} commodity.

Because of these properties of demand functions, several issues were considered in deciding how best to estimate substitutional, seasonal and regional patterns in the demand for salmon in Japan.

Substitutional Relationships

As discussed earlier, Asada found other seafood are not significant in salmon consumption and that meat is a likely predictive variable. Hirasawa indicates that medium quality seafood responds to the price of hogs. Thus it was decided to investigate substitutional relationships between salmon and pork. It was hypothesized that these two items are substitutes in consumption.

Seasonal Patterns

Between January and April there is no new supply of salmon in Japan. The consumer knows this and, thus, is not particularly interested in salmon consumption in this season. During May and June, the harvest of North Pacific salmon is offered in the retail shop. This product has a good reputation because of color and fat content. In the mid-summer, salmon will be a better item than red meat because Japanese summers are hot and humid. Cold rice and salmon are viewed as a good combination. After September the domestic set net catch begins. Recently harvests have been successful and advertising has begun to play an important marketing role. Thus the consumer is aware that returning salmon are in season. Finally there is an outstanding demand in December because of the New Year's celebration.

Regional Patterns

As discussed earlier, there are regional differences in food consumption in Japan, especially for seafoods. Tokyo and Osaka are the two largest cities in Japan but there are important cultural differences between them, including language. Tokyo's culture is more cosmopolitan with tastes of many countries represented; Osaka's population is more ethnic, traditional Japanese.

In the case of salmon, Hokkaido is a special region. Most of Japan's salmon are delivered to Hokkaido ports and there is a tradition of salmon consumption in that region.

Several decades ago the southern islands of Kyushu and Shikoku received no direct salmon deliveries from domestic landings. The demand for salmon in these regions is expected to be relatively weak because of this history and because of the availability of alternative seafoods.

VII. ECONOMETRIC ANALYSIS

Data on household consumption are available through Japan's monthly family income and expenditure survey (Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Japan). These data aggregate all salmon species together. These data, converted to a per capita basis, were used in an econometric analysis of salmon demand.

The question of the appropriate time period was considered next. The impact of the declaration of Exclusive Economic Zones in the mid to late 1970s by several foreign countries was very large. As a result, prices skyrocketed. Seafood dealers tried to take advantage of expected shortages by increasing seafood prices. But consumers reacted and, by 1980, price levels had stabilized. This suggests that dealers hypothesized a more price-inelastic demand for seafoods than is actually the case. Monthly data for the 1980-1985 period were used to estimate the price elasticities of demand for salmon with respect to both salmon and pork prices and to quantify the seasonal patterns described above. Regional data are available on only an annual basis. Furthermore, before 1979, separate data on prices and quantities are not available on a regional basis. Thus the regional analysis was conducted with annual data for the 1980-1985 period.

The log-linear specification was selected for the analysis. This function has the property of being non-linear and can be written in a fashion to satisfy the homogeneity restriction. It yields constant price and income elasticities and can be estimated with ordinary least squares. Among its disadvantages are that the Engel and Cournot aggregation restrictions are not automatically satisfied (see Deaton and Muellbauer, pages 17 and 18).

To account for seasonal variations in demand for agricultural and seafood products, researchers have taken several approaches. These include use of dummy variables (see, for example, Baker and Mori, Brown and Lee, Foote) and trigonometric functions (Waugh and Norton). The first was chosen for this analysis because seasonal demands are not expected to have the smooth and regular patterns of trigonometric functions.

The results are:

$$\log X_1 = -13.67 + \underset{(10.84)}{1.86} \log \left(\frac{y}{P}\right) - \underset{(-8.79)}{.87} \log \left(\frac{p_1}{P}\right) + \underset{(3.45)}{.84} \log \left(\frac{p_2}{P}\right) + \underset{(6.46)}{.16} D_1 + \underset{(4.60)}{.15} D_2 + \underset{(10.85)}{.22} D_3 + \underset{(4.24)}{.35} D_4 \qquad (1)$$

(t values in parentheses)

$n = 72$

$R^2 = .98$

Durbin-Watson Test = 2.19

where X_1 is the quantity of salmon consumption per capita

P is the consumer price index of food

y is the food expenditure per capita

p_1 is the retail price of salmon

p_2 is the retail price of pork

D_1 is a dummy variable (= 1 for May and June; otherwise = 0)

D_2 is a dummy variable (= 1 for July and August; otherwise = 0)

D_3 is a dummy variable (= 1 for September, October and November; otherwise = 0)

D_4 is a dummy variable (= 1 for December; otherwise = 0)

The findings support the relationships hypothesized earlier. The estimated price elasticity of per capita monthly demand for salmon in Japan is less than unity,[9] while the cross-price elasticity is positive. The income (actually, food expenditure) elasticity is greater than unity suggesting that, in Japan, salmon is a "luxury" (Deaton and Muellbauer, page 17). The demand apparently increases as the year progresses, although, for the period May to August, the demands are unchanging. During the period when the harvest from the domestic set net fishery is available, consumer demand increases somewhat. In December, because of New Year's consumption, the demand increases dramatically. After that, at the beginning of the following year, monthly demand is lowest.

The R^2 statistic for the equation is .98. The Durbin-Watson test statistic is 2.19, suggesting that autocorrelation is not a problem.

All of the variables are statistically significant at the .01 probability level. An F test determined that the seasonal variables are jointly significant in explaining variation in log X_1.

The questions of substitutes for salmon were explored further. Equation (1) was expanded to include the prices of beef and chicken. The results are:

---

[9]At the 5% level, the hypothesis that the price elasticity is unity cannot be rejected, however.

$$\log X_1 = -12.57 + \underset{(10.53)}{1.85} \log \left(\frac{y}{P}\right) - \underset{(-6.39)}{.89} \log \left(\frac{p_1}{P}\right)$$

$$+ \underset{(1.65)}{.62} \log \left(\frac{p_2}{P}\right) - \underset{(-.55)}{.21} \log \left(\frac{p_3}{P}\right) + \underset{(.81)}{.29} \log \left(\frac{p_4}{P}\right) \quad (2)$$

$$+ \underset{(6.44)}{.16} D_1 + \underset{(4.50)}{.16} D_2 + \underset{(10.44)}{.22} D_3 + \underset{(3.71)}{.36} D_4$$

(t values in parentheses)

$n = 72$

$R^2 = .98$

Durbin-Watson Test = 2.20

where X_1 is the quantity of salmon consumption per capita

P is the consumer price index of food

y is the food expenditure per capita

p_1 is the retail price of salmon

p_2 is the retail price of pork

p_3 is the retail price of beef

p_4 is the retail price of chicken

D_1 is a dummy variable (= 1 for May and June; otherwise = 0)

D_2 is a dummy variable (= 1 for July and August; otherwise = 0)

D_3 is a dummy variable (= 1 for September, October and November, otherwise = 0)

D_4 is a dummy variable (= 1 for December; otherwise = 0)

The coefficients of $\log (\frac{p_2}{P})$, $\log (\frac{p_3}{P})$ and $\log (\frac{p_4}{P})$ are not significant at 10% probability level. Including the two new price variables appears to add no new information. There is little change in the values of the coefficients for the variables of Equation (1). An exception to this is the coefficient on the pork price variable, whose size fell, while the estimated standard error rose. The estimated coefficient on the beef price variable is negative, with a high standard error. The coefficient on the chicken price variable is positive and, again, the standard error is high.

Multicollinearity may be a factor. The simple correlation between the chicken and pork prices (in logarithms) is .7; between chicken and salmon prices (in logarithms) is almost .7. Thus it cannot be concluded that salmon consumption is not affected by beef and chicken prices. However, this research does not uncover a relationship.

Next, the symmetry relationship was explored. For this purpose it was necessary to estimate the cross-price elasticity of demand for pork with respect to the price of salmon. Again, the log-linear functional form was used, with the following results:

$$\log X_2 = -1.37 + \underset{(6.28)}{.65} \log\left(\frac{y}{P}\right) + \underset{(4.34)}{.26} \log\left(\frac{p_1}{P}\right) \underset{(-.44)}{-.07} \log\left(\frac{p_2}{P}\right) \underset{(-1.05)}{-.02} D_1 - \underset{(-3.89)}{.08} D_2 + \underset{(4.45)}{.06} D_3 - \underset{(-2.10)}{.10} D_4 \qquad (3)$$

(t values in parentheses)

$n = 72$

$R^2 = .73$

Durbin Watson Test = 1.18

where X_2 is the quantity of pork consumption per capita

P is the consumer price index of food

y is the food expenditure per capita

p_1 is the retail price of salmon

p_2 is the retail price of pork

D_1 is a dummy variable (= 1 for May and June; otherwise = 0)

D_2 is a dummy variable (= 1 for July and August; otherwise = 0)

D_3 is a dummy variable (= 1 for September, October and November, otherwise = 0)

D_4 is a dummy variable (= 1 for December; otherwise = 0)

The coefficient of interest is that for log $(\frac{p_1}{P})$. The presence of autocorrelation suggests that caution should be used in interpreting the results. Nonetheless the estimated coefficients are unbiased.

Deaton and Muellbauer interpret the estimated elasticities in equations (1) and (3) as compensated elasticities, while Brandow views them as uncompensated elasticities. When interpreted as compensated elasticities, the symmetry relationship holds very closely. The relevant, estimated magnitudes are:

$w_1 = .00788$

$e^*_{12} = .84$

$w_2 = .0316$

$e^*_{21} = .26$

where w_1 and w_2 are average expenditures shares for salmon and pork, respectively, and e^*_{ij} is the compensated price elasticity of demand for i with respect to the price of j. Suppose the "true" value of e^*_{12} were .84. Then under the symmetry relationship, Chapter 6 (b), e^*_{21}, should be

$$\frac{w_1 e^*_{12}}{w_2} = .21$$

In fact the estimated e^*_{21} value was .26, with a standard error of 0.06. Thus, the "calculated" e^*_{21} value is within one standard error of the value estimated in equation (3). A similar argument can be made if the coefficients are interpreted as uncompensated elasticities. This is largely the result of the small shares of pork and salmon in household food expenditures. In any event, here is additional support for the hypothesis that salmon and pork are substitutes in the demand for salmon in Japan.[10]

---

[10]A linear specification was also examined. The results are:

$$X_1 = -38.16 + \underset{(7.44)}{.0059} \left(\frac{y}{P}\right) - \underset{(-8.89)}{.40} \left(\frac{p_1}{P}\right) + \underset{(3.50)}{.51} \left(\frac{p_2}{P}\right)$$

$$+ \underset{(5.79)}{11.31}\, D_1 + \underset{(5.13)}{13.96}\, D_2 + \underset{(9.60)}{15.66}\, D_3 + \underset{(10.87)}{87.11}\, D_4$$

(t values in parentheses)
$n = 72$
$R^2 = .99$
Durbin-Watson Test = 1.81

where X_1 is the quantity of salmon consumption per capita
P is the consumer price index of food
y is the food expenditure per capita
p_1 is the retail price of salmon
p_2 is the retail price of pork
D_1 is a dummy variable (= 1 for May and June; otherwise = 0)
D_2 is a dummy variable (= 1 for July and August; otherwise = 0)
D_3 is a dummy variable (= 1 for September, October and November; otherwise = 0)
D_4 is a dummy variable (= 1 for December; otherwise = 0)

All coefficients are significant at the 1% probability level. This result suggests that the demand shift during the fall months is not as great as indicated by the log linear model. Estimated price, cross-price, and income (food expenditure) elasticities are -.84, .81, and 1.30, respectively. These results are close to those generated by the log-linear model, suggesting that calculated elasticities (at the means of the relevant variables) may be relatively insensitive to functional form.

Finally, the question of regional differences was examined. The same data source used for the substitutional and seasonal analysis is used again. However, for this part of the analysis, annual data were used, because monthly data are not available on a regional basis.

Regional patterns were investigated between 1980 and 1985. Five regions were selected, namely, Hokkaido, Tokyo (Kanto-region), Osaka (Kinki-region), Shikoku and Kyushu. Dummy variables were used to permit an examination of regional differences and to address possible problems of heteroscedasticity. The results are:

$$\log X_1 = -5.54 + \underset{(1.33)}{1.05} \log \left(\frac{y}{P}\right) - \underset{(-5.41)}{.80} \log \left(\frac{p_1}{P}\right) + \underset{(2.39)}{.92} \log \left(\frac{p_2}{P}\right)$$

$$- \underset{(-10.45)}{.78} D_1 - \underset{(-10.24)}{1.09} D_2 - \underset{(-18.82)}{1.51} D_3 - \underset{(-24.94)}{1.51} D_4$$

(t values in parentheses)

$n = 30$

$R^2 = .996$

where X_1 is the quantity of salmon consumption per capita

P is the consumer price index of food

y is the food expenditure per capita

p_1 is the retail price of salmon

p_2 is the retail price of pork

D_1 is a dummy variable (= 1 for Tokyo (Kanto-region); otherwise = 0)

D_2 is a dummy variable (= 1 for Osaka (Kinki-region); otherwise = 0)

D_3 is a dummy variable (= 1 for Shikoku; otherwise = 0)

D_4 is a dummy variable (= 1 for Kyushu; otherwise = 0)

The coefficients of log $(\frac{P_1}{P})$ and all dummy variables are significant at the 1% probability level. The coefficient of log $(\frac{P_2}{P})$ is significant at the 5% level and that of log $(\frac{y}{P})$ is significant at the 20% level. The coefficients of log $(\frac{P_1}{P})$ and log $(\frac{P_2}{P})$ are not much different from the result of equation (1).

The results suggest that there are clear regional differences. That is, the further the distance from Hokkaido, the less the salmon demand. The demand in Shikoku and Kyushu is smallest and the coefficients for these two regions are almost identical. The coefficients of all the regional variables are statistically significant at the 1% level. Furthermore an F test revealed that, taken together, the regional dummy variables are statistically significant. Without those regional variables the R^2 statistic fell from .996 to .81. Thus the results suggest that there are regional differences in the household demand for salmon, as hypothesized.

VIII. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This research found that the estimated income elasticity of consumer demand for salmon in Japan is greater than unity while the own-price elasticity is less than -- but very close to -- unity (in absolute value). This suggests that, as Japanese incomes increase in the future, consumption of salmon may also rise above its present level. The findings also indicate that pork -- as opposed to beef and chicken -- is a substitute for salmon at the consumer level.

There appear to be some seasonal differences in the demand for salmon. In December the demand is greater than during the rest of the year, but this is followed by a downward shift in demand for the January-April period.

It is also clear that there are apparent regional differences. The results suggest that the demand in Hokkaido is greater than that in Tokyo and that Tokyo's demand is greater than Osaka's. However, Osaka's people are more likely to buy more expensive salmon than are consumers elsewhere in Japan, possibly reflecting species differences. Therefore, while the estimated Osaka dummy variable was more negative than the Tokyo dummy variable, it would be dangerous to conclude that the demand for salmon in Tokyo is greater than the demand in Osaka. Regional differences appear to exist but their nature requires further explanation.

Results also suggest that the coefficients for the Shikoku and Kyushu variables are the same. Some differences were expected because the two islands are geographically separate. However the two cultures may be similar -- and different from the culture in the rest of Japan.

Suggestions for Further Research

In the southern part of Japan, the yellowtail is a popular species, just as salmon is in Hokkaido. Thus, research that focuses on whether substitutional relationships among salmon, other seafoods, and meat products in December are different for the various regions could be explored further. Just as whole turkeys are popular at Thanksgiving in the U.S., whole fish are popular for the New Year celebration in Japan. In December, this may be reflected in substitutional relationships in demand between whole salmon and whole yellowtail. Such substitutional relationships may be different in the southern than the northern parts of Japan, for reasons discussed earlier. Appropriate data for such an analysis may be difficult to acquire, however.

Analysis of the kind conducted in the present study would be used in further exploration of the long-term, substitutional relationships among seafoods and meat products. Production of the latter has been increasing in Japan and analysis of a longer time series may generate insights into the impact on seafood markets, including salmon, over time.

This research revealed that retail salmon prices are higher in Osaka than elsewhere. This may reflect more than transportation costs. Specifically, it could indicate that a different species mix is being consumed in Osaka than elsewhere, with more red (sockeye) salmon in the Osaka consumer's diet. Thus further analysis of regional demand patterns could explore species differences among regions. The import dealer is aware that Osaka people will buy expensive salmon. Thus they are eager to explore more markets in Osaka.

This research found that the consumer demand for salmon is higher in Tokyo than in Osaka. However, the demands may be for different species (or species mixes), which future research could explore. Again, however, appropriate data may be difficult to obtain.

BIBLIOGRAPHY

Akitani, S. and K. Kase. 1986. "Shyuto-ken ni Okeru Sake no Kyoukyu-Ryutsu-Kouzou ni Kansuru Chyousa Kenkyu." Tokyo-to Seisen Shyokuhin Ryutsu Center. (In Japanese.)

Asada, Y. 1985. "Suisanbutsu Yunyu to Kakaku Keisei." Suisanbutsu Jyuyou Kouzou no Henka to Kakaku Keisei Kikou. Dainihon Suisankai. (In Japanese.)

Baker, G. and H. Mori. 1985. "Strawmen in Trade Protectionism: The Case of Citrus Import Quotas." Western Journal of Agricultural Economics Volume 10, Number 2, pp. 378-343.

Brandow, G.E. 1961. "Interrelations Among Demands for Farm Products and Implications for Control of Market Supply." Bulletin 680, Interregional Publication for the State Agricultural Experiment Stations, Agricultural Experiment Station, The Pennsylvania State University.

B.C. Ministry of Agriculture and Food. 1986. "The Market for Farmed Salmon: An Overview." Aquaculture Marketing, Marketing Branch, Canada. ISBN 0-7726-0510-6.

Brown, M.G. and J. Lee. 1986. "Orange and Grapefruit Juice Demand Forecasts." In Capps, Oral Jr. and Benjamin Senauer (eds.) Food Demand Analysis: Implications for Future Consumption. Department of Agricultural Economics, Virginia Polytechnic Institute and State University. Blacksburg, Virginia, pp. 215-232.

Deaton, A. and J. Muellbauer. 1980. Economics and Consumer Behavior. Cambridge University Press, Cambridge.

Foote, R.J. 1958. "Analytical Tools for Studying Demand and Price Structures." Agriculture Handbook No. 146, U.S. Department of Agriculture, Agricultural Marketing Service, Washington, DC.

George, P.S. and G.A. King. 1971. "Consumer Demand for Food Commodities in the United States with Projections for 1980." Giannini Foundation Monograph Number 26, Giannini Foundation of Agricultural Economics, California Agricultural Experiment Station, University of California Division of Agricultural Sciences.

Hirasawa, Y. 1983. "Demand and Market Conditions for Fishes in Japan, Especially Minced Alaska Pollock." In Proceedings of the International Seafood Trade Conference, Alaska Sea Grant Report No. 83-2, Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska, pp. 81-99.

Kobayashi, T. 1986. "Sake Gyogyo to Shigen Baiyou." Suisan Shinkou. Tokyo Suisan Shinkou-kai. Vol. 20-3, No. 19. (In Japanese.)

Taya, K. 1986. "Suisanbutsu Jyukyu to Kakaku Keisei." Suisanbutsu Jyuyou Kouzou no Henka to Kakaku Keisei Kikou. Dainihon Suisankai. (In Japanese.)

Toyokawa, H. 1986. "Shyokumotsu Shyoohi no Kouzou to Sakana no Shyoohi." Suisan Shinkou. Tokyo Suisan Shinkou-kai. Vol. 20-1, No. 217. (In Japanese.)

Waugh, F.V. and V.J. Norton. 1969. "Some Analysis of Fish Prices." Working Paper No. 22, Division of Economic Research, Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C.

APPENDIX

APPENDIX:

DATA USED IN THE ANALYSIS

Table A-1. Monthly Data: January 1980 - December 1985 [Price (yen/100g) and expenditure figures deflated by the monthly consumer price index for food (1980=100). Expenditure (yen) and quantity (grams) data are per capita figures. Data arrayed: January, 1985; February, 1985; ... January, 1984; ... December, 1980.]

Table A-2. Annual Data by Region: 1980-1985 [Prices (yen/100g) and expenditure figures deflated by annual consumer price index of food (1980=100). Expenditure (yen) and quantity (grams) data are per capita figures. Data arrayed Hokkaido, 1985; Kanto, 1985; Kinki, 1985; ... Hokkaido, 1984; ... Kyushyu, 1980.]

Source: Annual Report on the Family Income and Expenditure Survey, Statistics Bureau, Management and Coordination Agency, Japan.

Table A-1. Monthly Data

	Month	Q of Sal	Food Exp	P of Sal	P of Hog	P of Bef	P of Chk
1	1	48.8	15752	172	133	281	89
2	2	57.4	16147	174	132	275	88
3	3	66.6	18502	173	130	276	87
4	4	66.8	17891	178	130	273	86
5	5	73.9	18887	180	130	273	87
6	6	75.5	18224	179	129	277	85
7	7	85.4	19509	180	131	274	85
8	8	85.2	20019	184	133	280	85
9	9	80.6	18039	174	132	277	86
10	10	85.4	18215	155	125	268	83
11	11	90.0	17806	149	125	277	85
12	12	214.3	26920	152	126	305	85
13	1	47.8	15940	164	136	280	93
14	2	58.3	16523	165	133	268	89
15	3	69.9	18494	162	133	267	89
16	4	74.9	18478	165	134	268	89
17	5	77.7	18268	174	136	271	90
18	6	86.0	18167	173	138	276	91
19	7	91.1	19652	174	138	277	91
20	8	95.4	20094	177	140	282	92
21	9	86.0	18118	171	137	272	91
22	10	82.3	18271	167	134	273	89
23	11	89.0	17716	163	134	278	90
24	12	205.6	26929	154	134	305	90
25	1	48.7	16012	194	139	298	96
26	2	55.0	16275	192	141	289	95
27	3	70.2	18538	185	141	286	94
28	4	73.7	18059	181	141	287	93
29	5	86.2	18807	181	140	279	92
30	6	84.8	18411	179	142	285	93
31	7	98.4	19843	175	144	286	94
32	8	102.9	20163	168	143	289	95
33	9	85.1	18085	167	141	278	94
34	10	88.0	18478	158	135	277	92
35	11	98.7	17925	141	135	282	92
36	12	229.5	27023	147	138	305	92
37	1	51.6	15849	186	136	297	97
38	2	51.1	16324	196	135	294	97
39	3	64.0	18558	193	135	291	97
40	4	66.1	18150	194	138	285	96
41	5	73.0	19231	199	142	289	97
42	6	77.8	18719	200	146	290	97
43	7	81.7	20184	205	150	297	97
44	8	91.0	20049	196	144	296	96
45	9	80.7	17808	191	140	280	94
46	10	81.7	18614	184	137	283	93
47	11	83.3	17931	187	139	291	96
48	12	211.9	27208	174	140	320	97
49	1	47.0	15757	201	137	299	98
50	2	52.8	16119	196	141	294	98
51	3	61.5	18410	192	142	294	100
52	4	62.3	18013	195	141	289	100
53	5	71.5	18369	194	141	270	100
54	6	73.9	17919	196	142	292	100
55	7	83.4	19190	200	143	293	99
56	8	87.3	19824	203	143	298	100
57	9	76.0	17547	196	140	285	99
58	10	78.1	18062	185	136	288	98
59	11	81.0	17685	185	135	291	98
60	12	222.2	26809	164	136	313	98
61	1	37.7	15948	213	138	321	100
62	2	46.6	16714	210	134	306	97
63	3	56.3	18429	204	133	305	97
64	4	63.6	17927	199	136	309	99
65	5	76.7	18816	197	137	309	100
66	6	85.3	18321	188	138	309	100
67	7	91.4	19687	191	141	312	101
68	8	87.7	20036	196	141	312	101
69	9	76.4	17902	198	137	301	99
70	10	75.1	18281	195	136	301	97
71	11	72.8	18013	192	134	297	97
72	12	191.9	26880	181	139	322	100

Table A-2. Annual Data by Region

	Q of Sal	Food Exp	P of Sal	P of Hog	Kanto	Kinki	Shikoku	Kyushyu
1	2372	219028	142	115	0	0	0	0
2	1151	237902	174	128	1	0	0	0
3	809	242818	208	149	0	1	0	0
4	534	207990	184	137	0	0	1	0
5	433	207872	176	125	0	0	0	1
6	2518	220126	144	123	0	0	0	0
7	1180	238878	169	134	1	0	0	0
8	839	237626	199	150	0	1	0	0
9	474	205746	188	141	0	0	1	0
10	502	210990	176	130	0	0	0	1
11	2745	225585	139	127	0	0	0	0
12	1206	238986	172	139	1	0	0	0
13	872	242966	200	157	0	1	0	0
14	451	207977	197	144	0	0	1	0
15	507	207520	185	135	0	0	0	1
16	2332	215777	160	125	0	0	0	0
17	1160	241265	191	140	1	0	0	0
18	822	240857	226	157	0	1	0	0
19	451	204872	215	142	0	0	1	0
20	406	209449	214	133	0	0	0	1
21	2335	220724	157	124	0	0	0	0
22	1119	235820	190	141	1	0	0	0
23	882	239086	224	156	0	1	0	0
24	406	199814	218	142	0	0	1	0
25	404	204917	213	133	0	0	0	1
26	2458	224477	163	122	0	0	0	0
27	1079	235707	198	136	1	0	0	0
28	868	243061	224	157	0	1	0	0
29	405	209669	219	143	0	0	1	0
30	411	209604	215	132	0	0	0	1