Analysis of Japanese Demand for Alaska Groundfish

Dae-Kyum Kim*

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Abstract

In 1977, the United States enacted the Magnuson Fishery Conservation and Management Act (MFCMA), which established U.S. Fisheries Conservation Zone (FCZ). The MFCMA grants preference to U.S. harvesters over foreign fleets in the U.S. FCZ. At present, the large stocks of groundfish in the U.S. FCZ off the Alaska coast have been under-utilized in the U.S. domestic market and the fisheries for these groundfish are dominated by foreign fleets. Hence, expected benefits from replacing foreign fisheries by domestic fleets will accrue to the U.S. fishery only by exporting the increased U.S. products to foreign countries. U.S. exports may be dependent on the price levels in the foreign markets raised by the reduced foreign catch from U.S. waters. In this paper, Japanese demand models for Alaska groundfish were estimated. The derived coefficient from the estimated models suggest that a decrease in the Japanese landings from the U.S. FCZ by a thousand metric tons will increase pollock price by 0.017 Yen/kg, cod price by 0.351 Yen/kg, flatfish by 1.074 Yen/kg, and ocean perch by 1.347 Yen/kg in the Japanese market. These results based on percentage would increase 19 percent for pollock price, 11 percent for cod price, 40 percent for flatfish, and 2 percent for ocean perch price.

Introduction

In 1977, the United States enacted the Magnuson Fishery Conservation and Management Act (MFCMA), by which the U.S. Fisheries Conservation Zone (FCZ) was established the

* Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

area extending between 3 and 200 nautical miles from the U.S. coastlines, over which the United States proclaimed Management National Jurisdiction.

With enactment of the MFCMA, a great deal of interest has been generated by the large stocks of groundfish off the Alaska coast, which have been under-utilized in the U.S. market. At present, these groundfisheries are dominated exclusively by foreign fleets with the exception of U.S. harvesters selling directly to foreign processors under joint ventures. The MFCMA grants preference to U.S. harvesters over foreign fleets in the U.S. FCZ. If the U.S. enforces regulations restricting operations of foreign fleets in the U.S. FCZ by the MFCMA, foreign marketing problems may arise for the increased U.S. harvests because most of the species taken by foreigners in the Alaska waters have been under-utilized in the U.S. domestic market.

The United States benefits of restricting operations of foreign fleets in the U.S. FCZ may be dependent on the price levels in the foreign markets raised by the reduced foreign catch from U.S. waters. For example, when the supplies of fish to a foreign country decrease dramatically because of restricting operations in the U.S. waters; then, if the increase in price is small, exports will not increase. However, with a high price rise for fish products in the foreign country, the U.S. exports of fish products will increase. Unless the increase in price is high enough in the foreign market, the U.S. fishing industry will not receive the benefit expected from restricting operations of foreign fleets in the U.S. FCZ. Everyone believes that restricting operations of foreign fleets will affect the prices in foreign markets, but no one can say by how much..

Previous studies of expected impacts under the extended fisheries jurisdiction were generally limited to the U.S. domestic price impacts, or to maximum fees which foreign countries are willing to pay for accessing U.S. fishery resources.

Vidaeus and Norton, Crutchfield, and Meuriot and Gates have estimated maximum fees which foreign countries are willing to pay for accessing U.S. fishery resources. Vidaeus and Norton, and crutchfield calculated access benefits as consumers' surplus changes in the foreign countries while Meuriot and Gates calculated producers' surplus because the ubiquity of international trade barriers suggests that consummers receive less weight than producers. All studies indicate that the fee could be raised substantially above their current levels without significantly reducing the quantities demanded.

Tsoa, Schrank, and Roy constructed an econometric model of U.S. demand for several groundfish products and found the demand to be income elastic and price inelastic. These results indicated that an increase in the supply of fish products in the United States will cause a drastic reduction in the price of fish products unless U.S. income, and therefore demand, rise substantially. Hence, expected benefits from restricting operations of foreign fleet in the U.S. FCZ will not accrue to the fishery unless the increased products are exported to foreign countries.

The purpose of this study is to quantify the expected price changes, in the Japanese market, caused by restricting operations of Japanese fleets in U.S. waters. Japan is the largest fisheries producing and consuming country in the world. Annually, 75-80% of all foreign catches within the U.S. FCZ were harvested by the Japanese fleet. In this paper, Japanese demand models for Alaska groundfish will be estimated. Japanese ex-vessel prices will be used as dependent variables. Japanese catch outside U.S. waters, Japanese catch inside U.S. waters, and Japanese total income will be used as independent variables. The species included in this study are pollock, cod, flatfish[1] and ocean perch. A demand model for each species is estimated. The cofficients between the price changes and the catch from U.S. waters are derived from the estimated models. The derived coefficents are applied to Japanese annual catch from U.S. waters to estimate price impacts in Japanese markets.

The Japanese Groundfish Fisheries in Alaska Waters

Since 1972, Japan became the largest fisheries producing country in the world, and production accounted for one-seventh of the world total. Today, the annual consumption of fish and shellfish of Japanese per capita is 65-70kg, which means that about a half of animal protein is from marine products. In 1983, Japan's total marine fisheries catch amounts to 11.9 millian tons, of which about one million tons were caught in the Alaska waters of the U.S. FCZ (Table 1 and Figure 1). Annual Japanese harvests from the U.S.

Table 1. All foreign fish catch in the U.S. Fishery Conservation Zone by region, 1977-83.

Year	North Atlantic (1)	Calfornia Oregon & Washington	Alaska	Hawaii & Pacific Islands	Grand Total
		Metric tons, round weight			
1977	186,652	134,033	1,378,718	22	1,699,425
1978	86,887	98,739	1,568,302	416	1,754,344
1979	64,106	117,329	1,468,267	218	1,649,920
1980	68,527	46,928	1,511,383	795	1,627,633
1981	77,068	71,307	1,505,668	647	1,654,690
1982	67,486	7,253	1,340,152	390	1,415,281
1983	40,868	—	1,271,753	163	1,312,784

(1) Cape Hatteras, North Carolina, Northward
Source: Fisheries of the United States, 1978−84.

1) Flatfish includes yellowfin sole and other flounders.

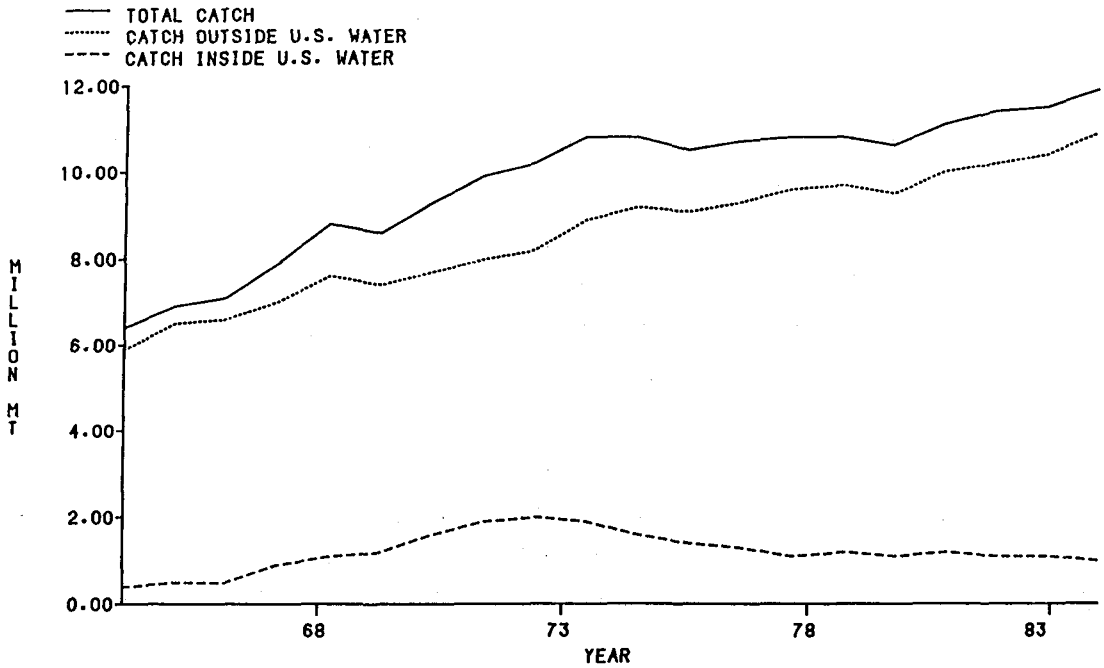

Fig. 1. Total Japanese catch by water, 1964-83

Table 2. All foreign fish catch in the Alaska waters of the U.S. Fishery Conservation Zone by country, 1964-83.

Year	Canada	USSR	Japan	Korea	Others	Total
			Metric tons, round weight			
1964	14,303	564,000	431,953	–	39,817	1,050,073
1965	13,979	462,000	450,662	–	36,808	963,449
1966	13,878	193,000	535,033	–	37,846	779,757
1967	10,264	265,599	858,328	–	41,075	1,175,266
1968	12,251	218,652	1,060,061	–	34,364	1,325,328
1969	13,029	256,206	1,216,299	–	103,412	1,588,946
1970	11,612	362,419	1,599,055	4,620	57,117	2,034,823
1971	7,410	451,196	1,920,054	10,000	57,483	2,446,143
1972	5,806	535,760	2,036,530	13,222	56,011	2,647,329
1973	3,668	441,852	1,872,348	7,697	70,165	2,395,730
1974	1,539	532,794	1,649,415	40,000	75,653	2,299,401
1975	2,276	448,088	1,404,944	18,755	71,941	1,946,004
1976	2,487	376,382	1,330,757	127,369	66,796	1,903,791
1977	5,033	177,226	1,113,335	80,157	2,967	1,378,718
1978	2,622	283,621	1,176,869	100,696	4,494	1,568,302
1979	1,086	181,822	1,106,919	128,002	232,090	1,649,919
1980	1,178	58,160	1,168,663	209,777	73,605	1,511,383
1981	–	–	1,148,744	242,982	113,942	1,505,668
1982	–	–	1,073,763	243,116	23,273	1,340,152
1983	–	–	968,197	279,692	23,864	1,271,753

Source: All-nation Removals of Groundfish, Herring, and Shrimp from the Eastern Bering Sea and Northeast Pacific Ocean, 1960-80.
Fisheries of the United States, 1982-84.

FCZ were 75-80% of all foreign catches within the U. S. FCZ (Tabl 2). The main species taken from Alaska waters were Alaska pollock, Pacific cod, flatfish, and Pacific ocean perch. The resources of these groundfishes have a wide distribution extending from off Baja California to the Alaska waters and southward along the Asian coast to Japan (Hart, 1973).

The Walleye pollock, *Theragra chalcogramma*

Pollock are distributed throughout the Northern Arc of the Pacific Ocean from California waters through the Gulf of Alaska and Aleutian Islands chain to waters off Japan and Korea (Figure 2). The Japanese pollock fishery in Alaska waters began in the mid-1950's.

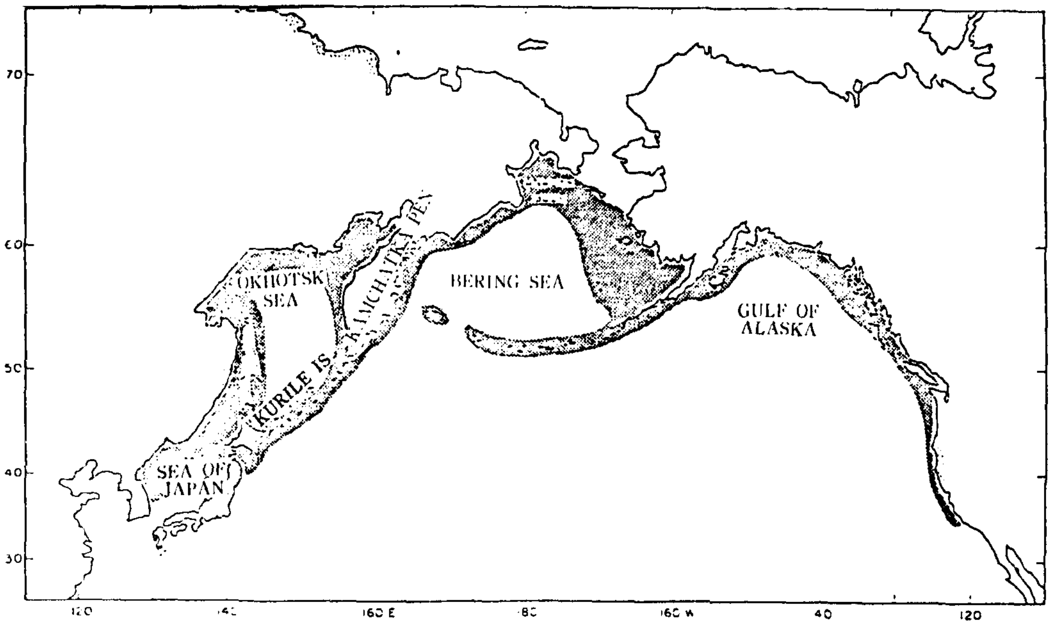

Fig. 2. Distribution of pollock, *Theragra chalcogramma*

Total catch from Alaska waters reached over 1.6 million metric tons in 1972, but has been declining in recent years. In 1983, Japanese catch in the U. S. FCZ was 0.7million metric tons. The catch taken in Alaska waters is significant since it has averaged over half of total Japan's pollock catch (Figure 3). Japanese harvests were about 75% of all foreign catches within the U. S. FCZ in 1983.

Pacific cod, *Gadus macrocephalus*

Pacific cod is wide-ranging, extending from waters off California northward and westward

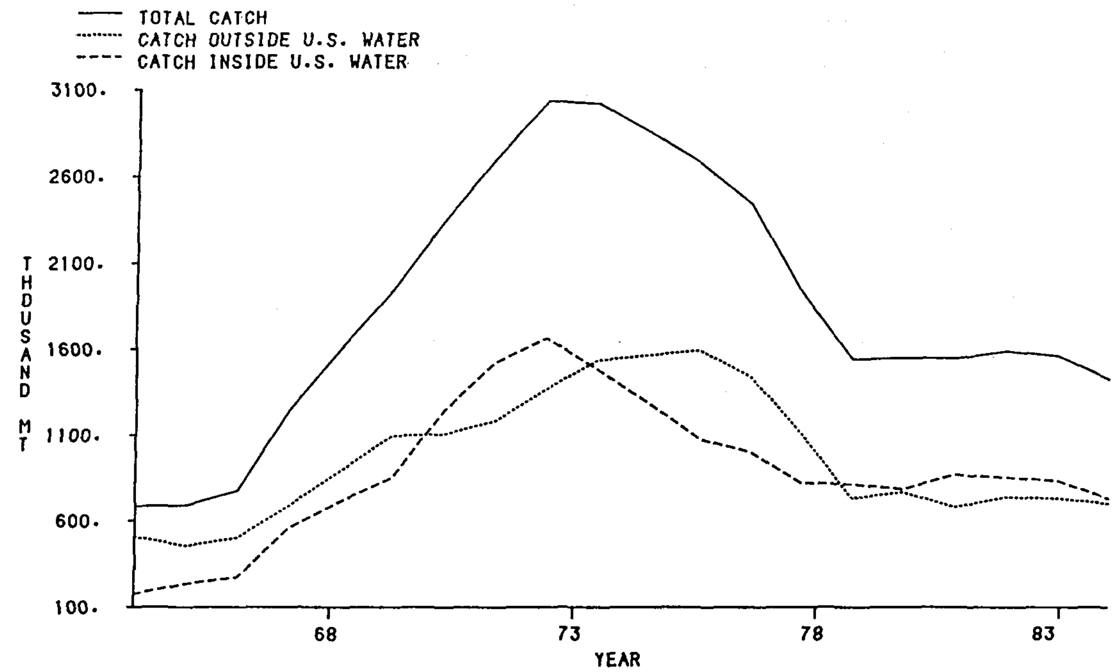

Fig. 3. Japanese pollock catch by water, 1964-83

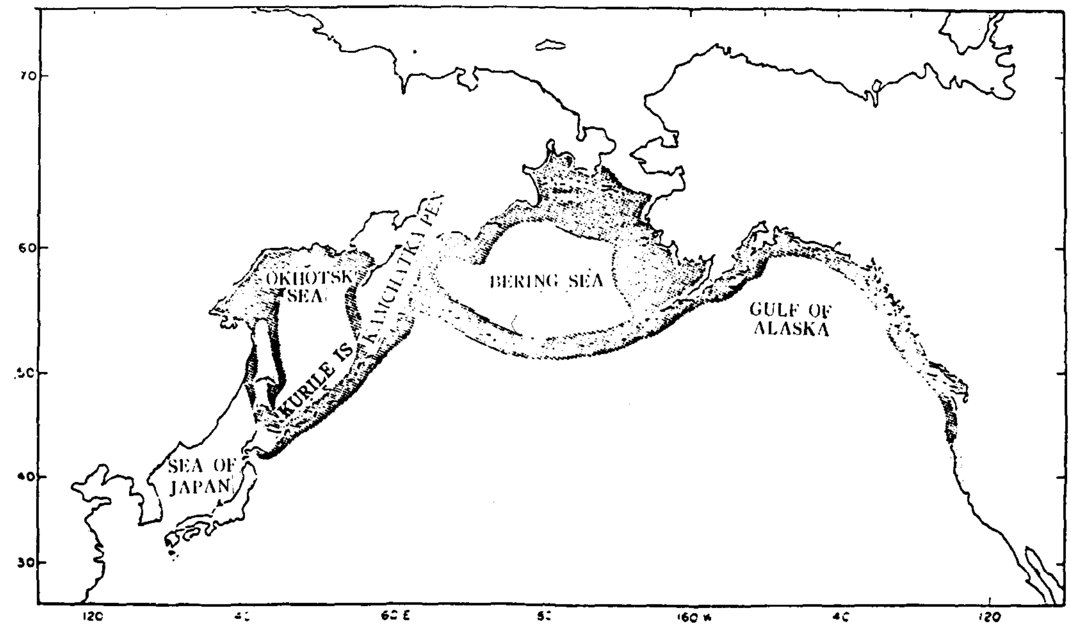

Fig. 4. Distribution of Pacific cod, *Gadus macrocephalus*

around the rim of the north Pacific Ocean, to the northern part of the Yellow Sea (Figure 4). The total Japanese landings of cod have remained relatively constant since 1970, but the total landings from the U. S. FCZ have declined steadily from 1970 to 1978 due to redu-

.ons of allowable harvests. Japan has increased the cod landings from other areas. Total ıpanese annual cod catches (including all species of cod) were over 100 thousand metric ons, of which 80-90% were caught in U.S. waters until 1974, but the catch from U.S. waters has declined to about 60% in recent years (Figure 5). Japanese harvests were about 78% of all foreign catches within the U.S. FCZ in recent years.

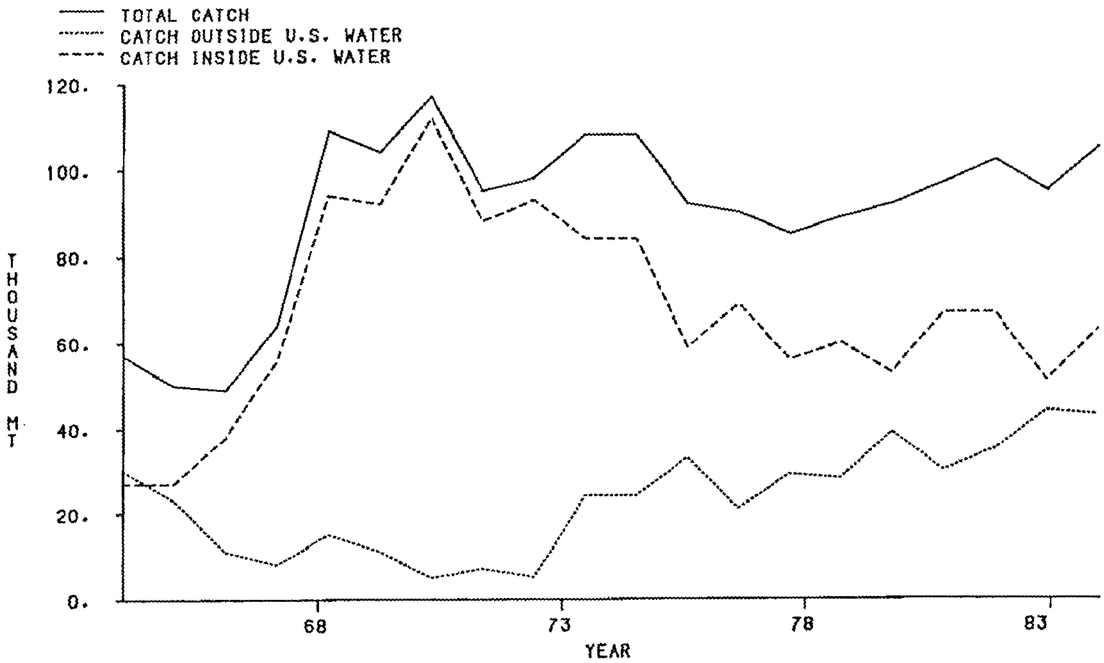

Fig. 5. Japanese cod catch by water, 1964-83

Pacific ocean perch, *Sebastes alutus*

Pacific ocean perch was the most abundant species of rockfish in the northeast Pacific Ocean and ranges from California to the Bering Sea and south along the Asian coast to Japan (Figure 6). Japanese total catch of ocean perch (including all species) reached over 100 thousand metric tons in 1973-74, but had been declining to under 20 thousand metric tons in recent years, mainly due to reductions of the landings from U.S. waters. The catch taken in U.S. waters is significant since it had averaged over 90% of Japanese total ocean perch catch(Figure 7). Japanese harvests from the U.S. FCZ are 87% of the foreign catches from the U.S. FCZ.

Flatfish

Yellowfin sole is the main flatfish which the Japanese have caught in the U.S. FCZ and is the most abundant in the eastern Bering Sea. It ranges south along the North American

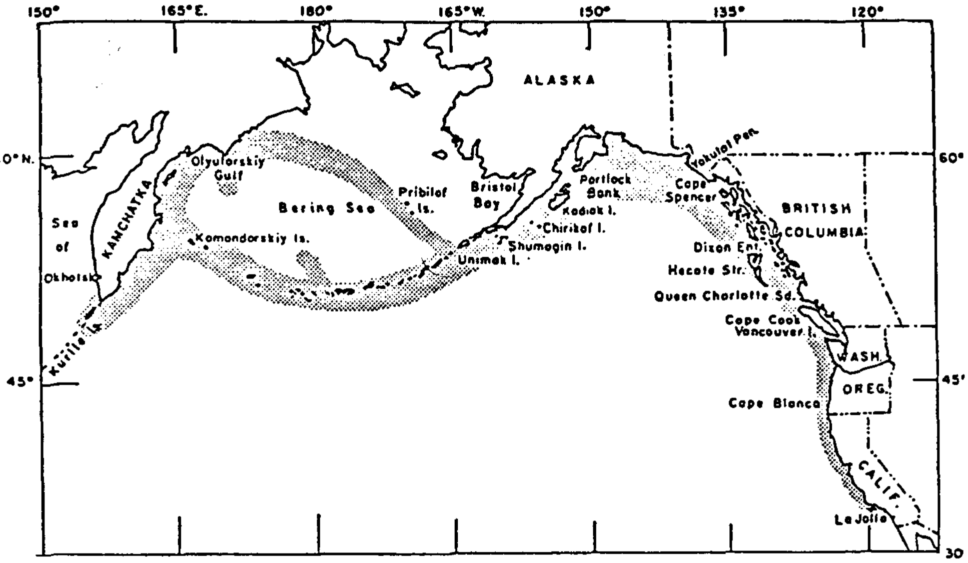

Fig. 6. Distribution of Pacific oceanperch, *Sebastes alutus*

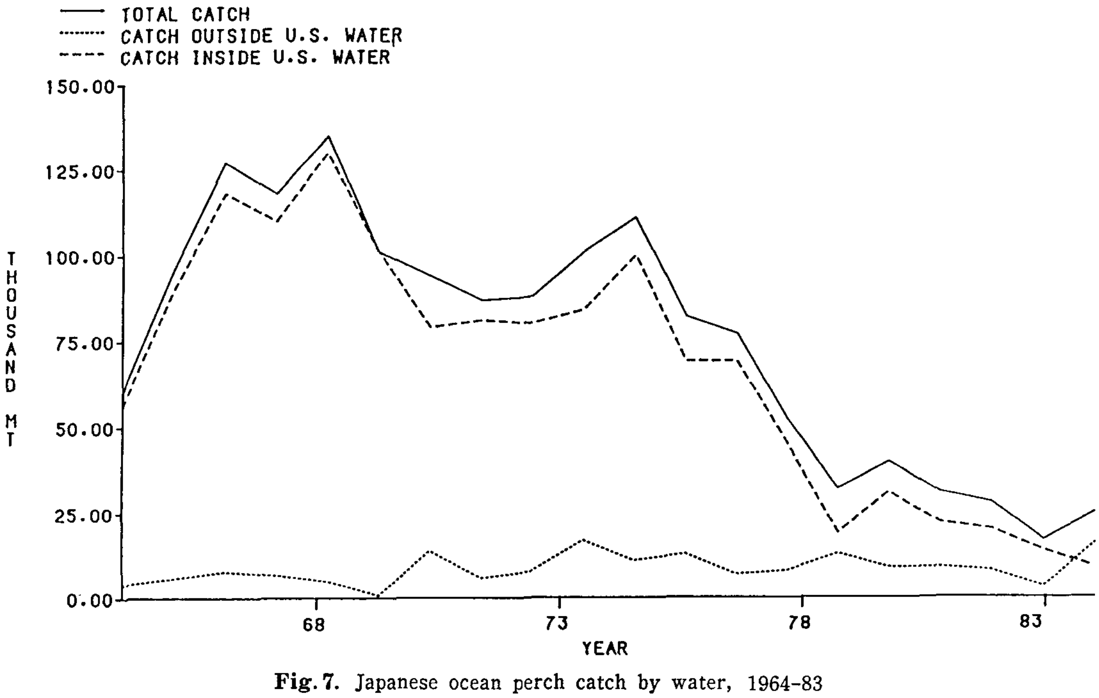

Fig. 7. Japanese ocean perch catch by water, 1964-83

coast to waters off northern British Columbia, but its abundance in the Gulf of Alaska is low and not sufficient to warrant a commercial fishery. On the Asian coast, they range from the Gulf of Anadyr southward to the coast of the Republic of Korea, and are fished commercially in Asia off the east and west coasts of Kamchatka and in certain areas of the Okhotska Sea(Figure 8). Japanese total catch of flatfish has been 300 thousand metric tons,

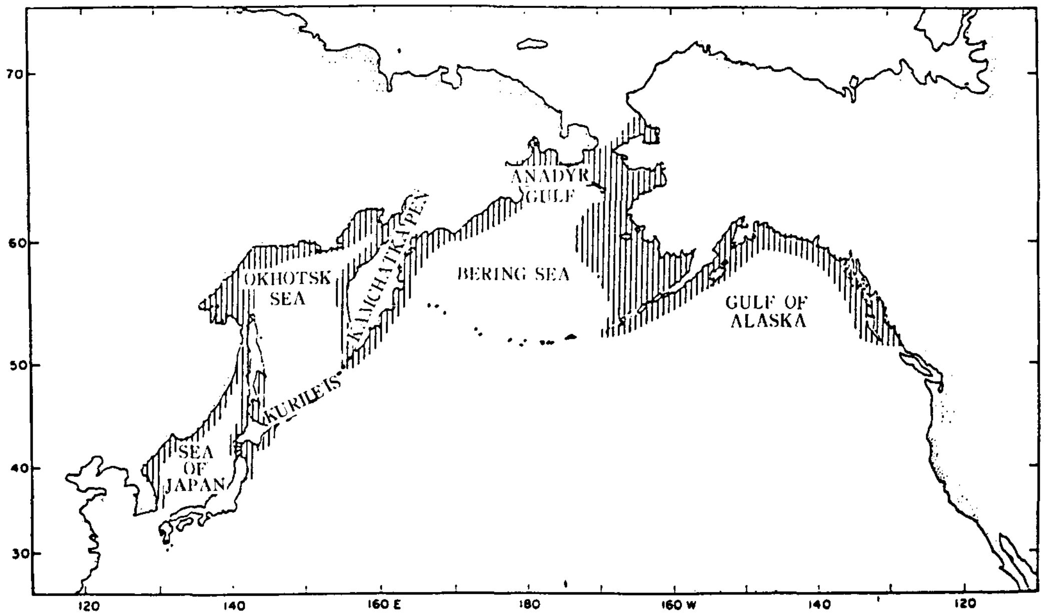

Fig. 8. Distribution of yellowfin sole, *Limandaaspera*

of which about 50% has been taken from U.S. waters. Those Japanese total catches and the catches from U.S. waters have remained relatively constant over the years (Figure 9). Japanese harvest from U.S. waters are about 80% of all foreign catches from U.S. waters.

The demand and supply relationships of Alaska groundfish in the Japanese market is

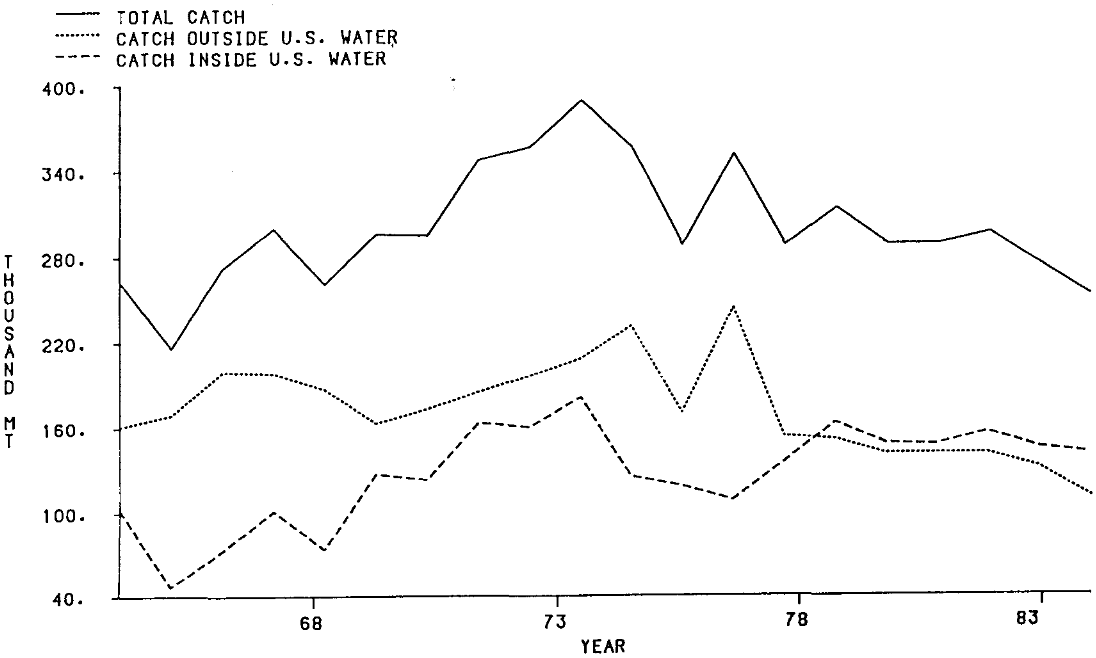

Fig. 9. Japanese flatfish catch by water, 1964–83

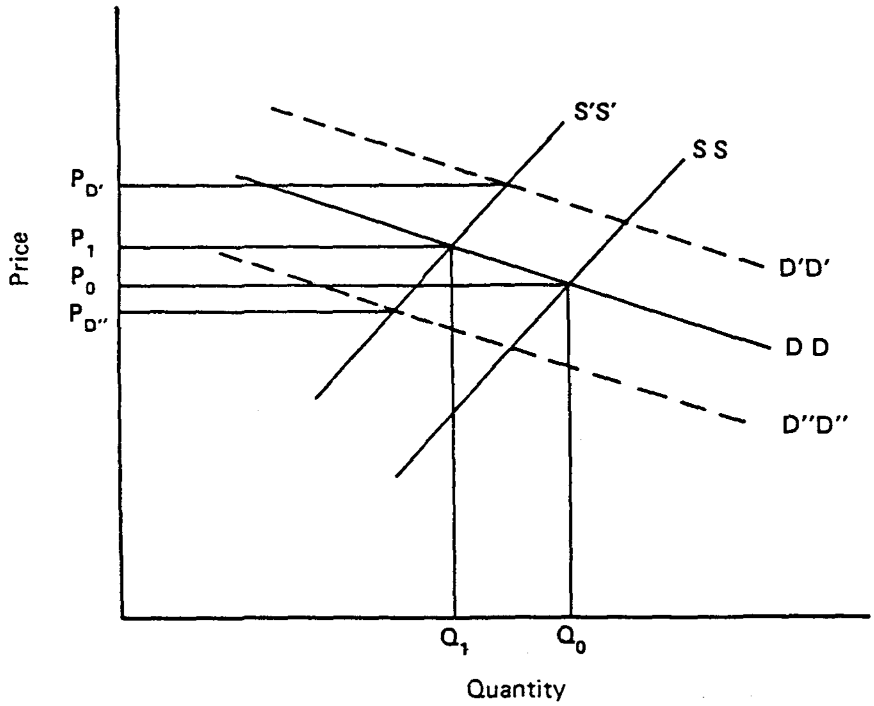

Fig. 10. Demand and Supply of Alaska Groundfish in the Japanese Market

illustrated in Figure 10. The demand curve DD represents the demand for groundfish at the dockside (ex-vessel) level. The supply curve SS exhibits total supplies including catch outside the U. S. FCZ and catch inside the U. S. FCZ. The supply curve S'S' represents only catch outside the U. S. FCZ. Therefore, SS minus S'S' represents catches inside the U. S. FCZ.

Before phasing out foreign fishing from U. S. waters, the market clears at price P_0 and quantity Q_0. Using the model, it is possible to illustrate the potential price impacts in Japan of the phase out from U. S. waters. If the potential price impacts in Japan of the phase out from U. S. waters. If the Japanese are phased out from U. S. waters, the market would clear with P_1 and Q_1, supply will decrease from Q_0 to Q_1, and price will increase from P_0 to P_1. In addition, a change in price P_1 can be caused by Japanese economic fluctuations. If Japanese economy is booming, the demand for the groundfish products will increase from DD to D'D' and price will increase from p_1 to $P_{D'}$. If Japanese economy is in recession, the demand will decrease from DD to D"D" and price will decrease from P_1 to $P_{D''}$.

Methodology and Empirical Results

The prices for proundfish in Japan are dependent on a number of factors in supply and demand functions. On the supply side, the catch outside U. S. waters and the catch inside U. S. waters might have an influence on the price while demand will be shifted by fluctuations of the Japanese economy, which may be represented by changes in Japanese national income.

The ex-vessel demand function for groundfish in Japan will, therefore, be represented by the following:

$$P_E = f(C, L_O, L_I, I); \qquad (1)$$

Where P_E is the ex-vessel price for groundfish in Japan, C is a constant, L_O and L_I are annual catches of groundfish by Japan outside and inside U. S. waters, respectively, and I is Japanese National Income. The data required for the estimation of the equations are prices, the catches outside and inside U. S. waters, and Japanese National Income. The data for ex-vessel prices and Japanese total catches (outside and inside U. S. waters) were taken from the *Fishery Pqoducts Marketing Statistics,* Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries, Tokyo, Japan. The data for the catches inside U. S. waters were taken from *All-Nation Removal of Groundfish, Herring, and Shrimp from the Eastern Bering Sea and NortheastPacific Ocean,* 1964-80. NMFS, F/NWC-14, U. S. Department of Commerce, September 1981 and *Fisheries of the United States,* 1981-1983, U. S. Department of Commerce. The data for the catches outside U. S. waters were obtained by subtracting catches inside U. S. waters from the Japanese total catches. Japanese National Income data are taken from *The Annual Report on National Accounts,* Economic Planning Agency, Tokyo, Japan.

The ex-vessel demand equations were estimated by means of ordinary least squares with data for the period of 1964-1983 (20 observations). The input data are prices in yen/kg, landings in thousand metric tons, and National income in thousand billion yen. The results are presented in Table 3. The empirical results of the least squares estimation process conform with a prior assumption for all four species. The sings of all the coefficients are consistent with prior expectations. The squared multiple correlation coefficients for all the models range .82-.91, which indicates a reasonably "good fit" for demand equation estimates from time-series data. The Durbin-watson statistics for the cod mode is above the critical value. The Durbin-Watson statistics for the other three models are inconclusive. These inconclusive results of the Durbin-Watson tests do not violate the validity of the magnitude of the estimated coefficient[2].

2) The statistical consequence of serial correlation is the presence of a bias in the estimation of the variance of the stochastic disturbance term. Thus, while the estimated coefficients are still consistent and unbiased, they no longer have a mimimun Variance, which means that the t-tests and F-tests are, in general, invalid. This problem raises some questions regarding the validity of the statistical relationship between price and landings, but not necessarily the magnitude of the estimated coefficients.

Table 3. Estimated coefficients for the multiple regression models by species, 1964-83.

	Independent variables						
Species	Constant	L_O	L_I	I	R^2	F Ratio	D-W
Pollock	5.501	−0.013 (.012)	−0.017* (0.010)	0.986* (0.133)	.82	22.56	1.06
Cod	1.065	−0.013 (0.819)	−0.351** (0.326)	2.426* (0.419)	.88	37.93	1.79
latfish	−35.762	−0.310 (0.208)	−1.074* (0.426)	6.537* (0.748)	.88	38.42	1.01
Ocean perch	−74.770	−5.745 (3.392)	−1.348* (0.792)	8.873* (1.414)	.91	51.45	1.08

(Standard errors in parentheses)
The regression equation for this model is specified in equation (1).
The dependent variables are annual ex-vessel prices of each species in the Japanese markets, 1964−83.
These price data are in current yen and are not adjusted by any price index.
Independent variables are as follows:

L_O = landings outside U.S. FCZ;
L_I = landings inside U.S. FCZ;
I = Japanese annual net national income;

* Indicate that the coefficient is significantly different from zero at $\alpha=0.05$.
** Indicate the coefficient is significantly different from zero at $\alpha=0.20$.

As reported in Table 3, a decrease in the Japanese landings from the U.S. FCZ by a thousand metric tons will increase pollock price by 0.017 yen-kg, cod price by 0.351 yen/kg, flatfish by 1.074 yen/kg, and ocean perch by 1.348 yen/kg. When we apply these price change ratios to total Japanese catches from the U.S. FCZ in 1983 by species, Japanese fish prices in 1983 would be changed from 64 yen/kg to 76 yen/kg for pollock, from 404 yen/kg to 566 yen/kg for flatfish, from 202 yen/kg to 224 yen/kg for 224 yen/kg for cod, and from 803 yen/kg to 815 yen/kg for ocean perch as shown in Table 4. That means; pollock price increase 19 percent, cod price 11 percent, flatfish 40 percent, and ocean perch 1.5percent.

Table 4. Actual and estimated prices caused by the phase out from U.S. waters in 1983.

Species	Actual prices	Estimated prices	Change
	············yen/kg···········		percent
Pollock	64	76	+18.8
Cod	202	224	+10.9
Flatfish	404	566	+40.1
Ocean perch	803	815	+ 1.5

Conclusion and Policy Implications

In this paper, a model of Japanese demand for various Alaska groundfish has been formulated. The purpose was to estimate the statistical relationship between price and landings from the Alaska waters.

The emprical results suggest that a decrease in the Japanese landings from the U. S. waters by a thousand metric tons will increase pollock price by 0.017 yen/kg, cod price by 0.351 yen/kg, flatfish price by 1.074 yen/kg, and ocean perch price by 1.348 yen/kg. Also, these price change ratios imply that Japanese fish prices in 1983 would rise from 64 yen/kg to 76 yen/kg for pollock, from 202 yen/kg to 224 yen/kg for cod, from 404 yen/kg to 566 yen/kg for flatfish and from 803 yen/kg to 815 yen/kg for ocean perch, if the United States enforces regulations restricting operations of total Japanese fleets in U. S. waters by the MFCMA. These results based on percentage would increase 19 percent for pollock price, 11 percent for cod price, 40 percent for flatfish price, and 2 percent for ocean perch price. Japanese catch of ocean perch from U. S. water is insignificant with about 2 percent of Japanese total catch of all species from U. S. waters. Therefore, the price of the major catch (98%) would increase from 11 to 40 percent. Theoretically, the United States can export Alaska groundfishes to Japanese markets at the above two price ranges for each species by adjusting the export quantities after phasing out total Japanese fleets from U. S. waters. However, further study is needed to ascertain the feasibility of exporting and prices needed at the export level.

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