日本のサケ漁業を取り巻く経済要因の影響

Bulletin of the National Salmon
Resources Center, No. 7:105-115
March 2005

さけ・ます資源管理センター
研究報告　第7号 105-115頁
2005年3月

Economic Factors Effecting Salmon Fisheries in Japan

Ikutaro Shimizu

Research Division, National Salmon Resources Center
2-2 Nakanoshima, Toyohira-ku, Sapporo 062-0922, Japan
(ikutaro@salmon.affrc.go.jp)

Abstract.— Salmon fisheries in Japan are facing a serious crisis and are being pressed to enact structural reforms. Though there has been a decline in high seas salmon fisheries, the total amount of salmon catches has increased year after year with a success of salmon enhancement. Salmon markets in Japan have consequently been globalized, and the price of domestic salmon in wholesale markets has dropped. In this paper, I described the fluctuation of salmon prices in the landing markets in Hokkaido in order to make clear the factors of price change, from both the short-term and long-term standpoints. Factors regarding the price formation of salmon in the wholesale market in Japan were analyzed by the econometric method. The wholesale price of fresh salmon fell when the inventory of frozen salmon or imported fresh salmon increased, and also the prices of fresh salmon have dropped when the inventory of salted salmon roe and fresh salmon increased in recent years. Since there was an increase in the amount of imported fresh salmon produced by salmon aquaculture in winter, there was an increase in the inventory of fresh salmon. In order to reduce inventory and stabilize the wholesale price, it is necessary to expand the market for domestic salmon by maintaining its freshness, developing new processed food, and ensuring its safety. Furthermore, analysis of the trend of consumers' tastes for salmon and a grasp of consumers' needs will be important for the supply side, such as Fishermen's Cooperatives and related organizations engaged in enhancement of salmon resources.

Key words: salmon fishery, wholesale price, import price, landing amount, imported amount, inventory amount

Introduction

Salmon fishery of Japan in the North Pacific Ocean was resumed in 1952 after the Second World War. Fishery production of salmon with mother ship fisheries and drift net fisheries in the North Pacific Ocean was 116,210 tons in 1955. It exceeded 28,431 tons in 1939, the maximum production before the Second World War. Canned salmon were mainly exported to England, depending on the increase of fishery production of salmon (Nakai 1988). Mother ship fishery was one of the minister-licensed fisheries and was operated by some mother ships and many fishing boats offshore, in the Bering Sea or in the east Kamchatka waters. Fishing boats caught fish with drift nets, the fish were transported to mother ships in waters, and then the fish were processed into foods on mother ships. This fishery started in 1929 and finished in 1989 with the 200-mile regulation.

On the other hand, drift net fishery was one of the governor-licensed fisheries and the minister limited the fishing effort and catch. The drift net fisheries in the west Pacific Ocean and the Japan Sea are minister-licensed fisheries. The drift net fishery in the Japanese exclusive economic zone (EEZ) is the governor-licensed fishery. Fishing boats go out fishing from ports and catch fish with drift nets in waters and return to their landing ports. The fishing grounds were reduced by the 200-mile regulation and drift net fishery has been operated in the partial EEZ. The drift net fishery in the Russian EEZ in the west Pacific Ocean has been continuing to operate based on the fishery agreement with Russia.

Though mother ship fisheries and drift net fisheries in the North Pacific Ocean declined with the 200-mile regulation, fishery production of matured salmon returned to coastal areas by set net fisheries, which increased rapidly with a success of salmon en-

Contribution A No. 38 from the National Salmon Resources Center.

hancement in the 1980s in the northern part of Japan. Set net fishery is one of the fisheries based on fishery rights and operated with fishing gear set off coasts. Returns of salmon are the main fish caught by set net fishery in Hokkaido. Set net fishery rights must be obtained before one can operate set net fishery, and these rights are renewed every five years. Salmon fishery with set nets is one of the most important fisheries in the northern part of Japan. But the wholesale price of domestic salmon peaked in 1978, after which it fell, and recently it has decreased to one-third of the peak. If the decline in the wholesale price of salmon was caused by the economic structure of salmon fisheries, it is necessary to change the production structure itself to cope with the changes in the economic situation.

Therefore, it is important to investigate the economic conditions in salmon fisheries, particularly the trend of demand and supply of domestic salmon and imported salmon, to investigate the trend of consumption in Japan and foreign countries, and to survey the relationship between demand and supply. I consider that the basic framework for structural reform will improve the market price.

In recent years, salmon set net fishery has suffered severe management conditions, because net income has been reduced due to the fall in the price of salmon. What was the cause of the slump in the price of autumn salmon in wholesale markets? The amount of imported salmon increased rapidly in the latter half of the 1980s, and domestic salmon had to compete with them. Has the price of imported salmon influenced the wholesale price of domestic salmon? What was the relation between the landing amount of domestic salmon and the amount of imported salmon? How has it influenced the wholesale prices of domestic salmon? In order to answer these questions, I investigated the changes in the average prices of domestic salmon at the landing ports in Hokkaido from long-term and short-term standpoints.

I did not discuss whether the structure of the wholesale prices had some influence on the landing amount, the import amount, and the inventory amount. Taya (1988) pointed out that the wholesale price of salmon was established based not only on the landing amount but also on the inventory amount at the beginning of the year. But Taya carried out his observations from 1979 to 1986, in a period when domestic salmon still predominated over import salmon. In other words, the situation was different from that in recent years. So I just tried to clarify the causality among the landing amount, import amount and inventory amount surrounding import salmon and domestic salmon by an econometric analysis from long-term standpoint.

Materials and Methods

The data regarding wholesale prices, landing amounts, inventory amounts, fishery production of salmon and private final consumption expenditure were taken from the Japanese Ministry of Agriculture, Forestry and Fisheries annual reports between 1965 and 2001. The data regarding import amounts, import prices, and export amounts were taken from the Japanese Ministry of Finance's import and export trade statistics. The wholesale prices of autumn salmon of Japan were taken from the annual report of the Set Net Fishery Association of Hokkaido. The prices were adjusted with reference to the consumer price index of the Statistics Bureau of Japan. Regarding the domestic salmon captured in autumn in Japan, one of the main fish is called "Sake", or chum salmon (*Oncorhynchus keta*), and another is called "Masu", or pink salmon (*O. gorbuscha*). The fishery production of masu salmon (*O. masou*) is included in "Masu" in Japanese statistics data. Imported salmon include sockeye salmon (*O. nerka*), Atlantic salmon (*Salmo salar*), trout (*O. mykiss*), coho salmon (*O. kisutch*) and others.

The parameters of the wholesale prices were the price of fresh "Sake" (PF), the price of salted "Sake" (PS), the price of fresh "Masu" (PMF), and the price of salted "Masu" (PMS). The parameters of fisheries production were the quantity of fresh "Sake" (QF), the quantity of salted "Sake" (QS), the quantity of fresh "Masu" (QMF) and the quantity of salted "Masu" (QMS). The parameters of inventory amounts in the end of December were the inventory of frozen "Sake" (ZF), the inventory of salted "Sake" (ZS), the inventory of frozen "Masu" (ZMF), the inventory of salted "Masu" (ZMS) and the inventory of salted salmon roe "ZE". The parameters of import prices were the import price of salmon (PI) and the import price of salted salmon roe (PIE). The parameters of import amounts were the quantity of import salmon (QI) and the quantity of import salted salmon roe (QIE). Other parameters were the private final consumption expenditure (C) and the exchange rate (R).

The causality of these economic parameters was measured to determine the influence of variables by using the Granger Test of EViews 4 (Quantitative Micro Software) (Matsuura and Mckenzie 2001; Takigawa and Maeda 2004). A price function model was defined as follows:

$\ln P=e_0+e_1\ln Q+e_2\ln Z+e_3\ln C$, P=wholesale price, Q=landing amount, Z=inventory amount and C=national income (Ariji 2000). Values of elasticity (e_n) were estimated by the econometric method of TSP/Give Win 4.5 (TSP International) (Nawada 1997; Minotani et al. 1997; Shirasago 1998).

Results

Cause of the slump in the price of autumn salmon wholesale markets

The total amount of domestically produced salmon was only 1.5% of Japan's entire fishery production until the first half of 1980s. Domestic production of salmon increased rapidly from the latter half of the 1980s, until it reached the current amount of 5% of the total. While the entire amount of fishery production was declining, the amount of domestically produced salmon was increasing. The amount of domestically produced salmon by mother ship fishery and drift net fishery in Japan was about 50% of Japan's entire fishery production until 1973. But it decreased year by year, and was less than 20% after 1985, when the production amount by mother ship fishery and drift net fishery declined. On the other hand, the percentage of set net fishery produced salmon was less than 50% before 1977, and it was over 70% in 1984. Comparing the annual production amount of salmon by set net fishery and by other fishery, the amount by other fishery except set net was more than 90,000 tons until 1975, less than 50,000 tons after 1978, and 30,000-40,000 tons afterwards. However, the amount produced by set net fishery was 20,000-40,000 tons until 1974, more than 100,000 tons after 1983, and 150,000 tons in 1989. Furthermore, the amount of salmon produced by set net fishery increased to 230,000 tons in 1997, reaching 86% of the amount of domestic production (Fig. 1).

The average household consumption of salmon increased from 1977 to 1982, and the import amount of fresh and frozen salmon also increased rapidly. But the export amount of salmon decreased in the latter half of 1970s. The annual import amount of

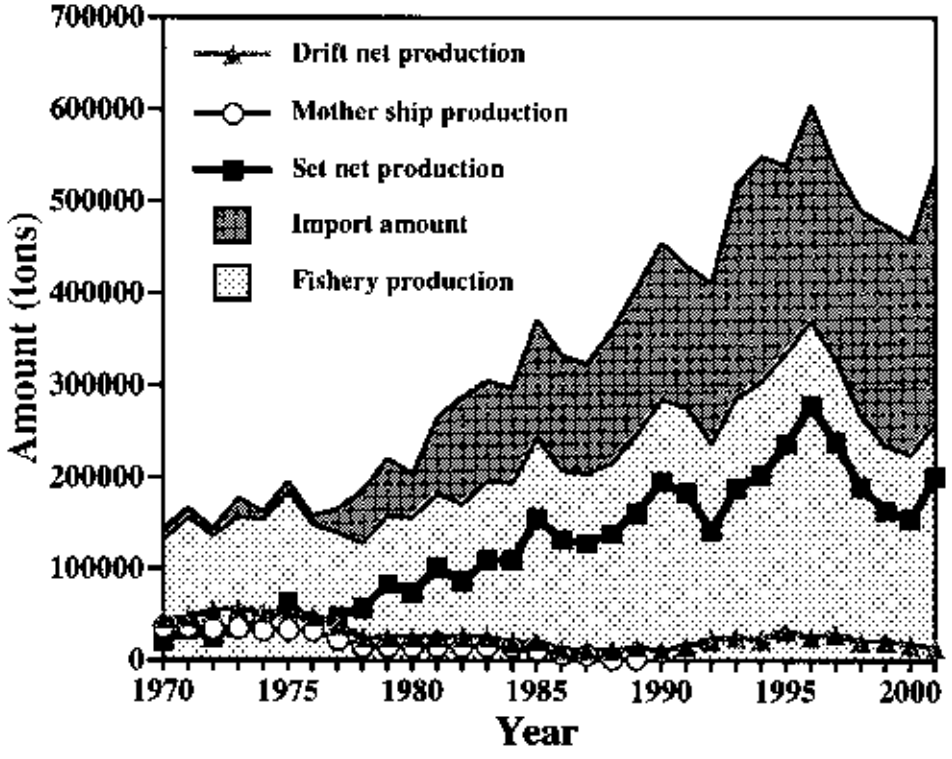

Fig. 1. Changes in fishery production and import amounts of salmon in Japan 1970 to 2001.

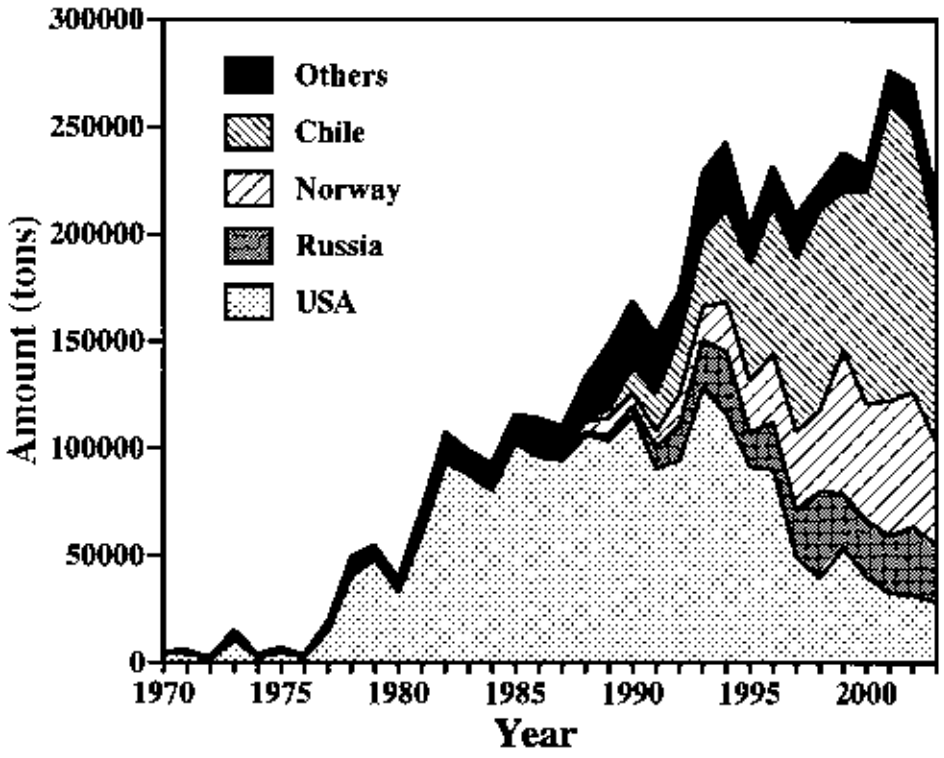

Fig. 2. Changes in import amounts of salmon from main countries from 1970 to 2003.

salmon was 50,000 tons in the first half of 1980s, and it increased rapidly afterward. The annual import amount of salmon reached about 250,000 tons at the peak of the first half of 1990s. It changed by 210,000-230,000 tons in the latter half of 1990s. The amount of imported salmon in 1999 from Chile was 74,000 tons, from Norway 67,000 tons, from the United States 54,000 tons, from Russia 25,000 tons and from Canada 7,000 tons, for a total of 238,000 tons (134,000 million yen). The import amount of salmon from Chile and Norway accounted for 59% (63% in value) of the total import amount of salmon. Though the increase in the amount of imported salmon from Chile slowed down a little and that in the amount imported from the United States decreased, the amount imported from Norway increased rapidly over these several years (Fig. 2).

Because chum salmon was the main fish among the products caught with salmon set nets, the change in the wholesale prices of salmon was examined by the average prices of fishery products with set nets. While non-set net fisheries whose main fishery was a mother ship fishery declined with the establishment of the EEZ, the exchange rate of yen for dollar dropped from 237 yen in 1984 to 103 yen in 1994. Because the price of salmon produced in foreign countries decreased relative to the strong yen, the amount of imported fresh salmon increased rapidly. The relationship between the amount (I) of imported fresh salmon in Japan and the average prices (P) of fresh salmon in Hokkaido from 1978 to 2000 was shown as follows: P=1200-0.00375I, P (yen per kg), I (tons), r^2=0.798, p<0.001. In addition, the relationship between the import prices (IP) of fresh salmon in Japan and the average prices (P) of fresh salmon in Hokkaido from 1978 to 2000 was shown as follows: P=1.173IP-268, IP (yen per kg), P (yen per kg), r^2=0.754, p<0.001 (Fig. 3).

The following tendency was shown in the relationship between the fishery production amount of salmon with set nets and the average prices of salmon. The average price increased in the years when the fishery production amount decreased from the previous year and the average price decreased in the years when the fishery production amount increased from the previous year. Also, the following tendency was shown in the relationship between the landing amounts of fresh salmon and the wholesale prices at landing ports in Hokkaido. Though the

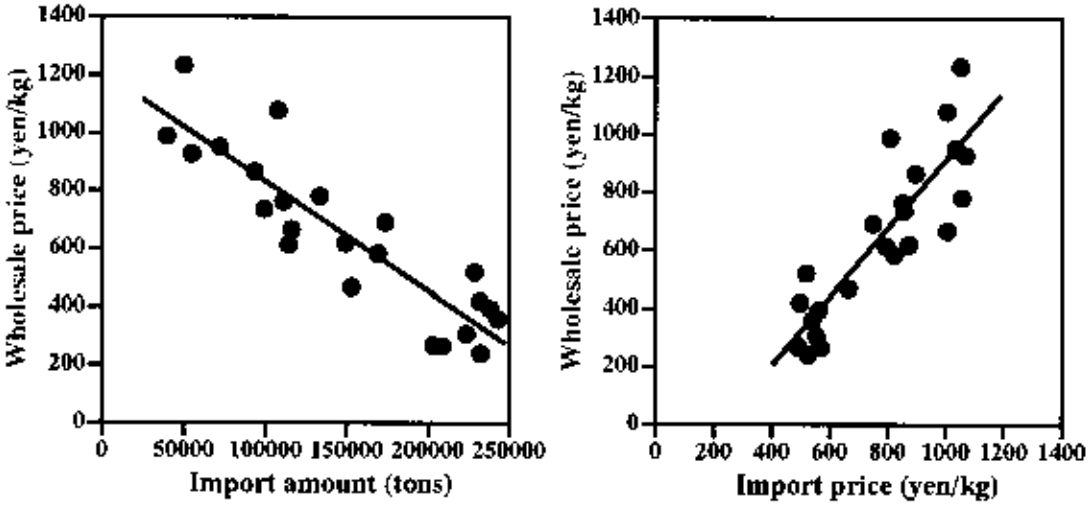

Fig. 3. Relation between wholesale price of fresh salmon at landing ports in Hokkaido, and amount (left figure) and price (right figure) of imported fresh salmon in Japan from 1978 to 2000.

wholesale price in the years when the landing amount decreased less from the previous year increased from the previous year, the wholesale price in the years when the landing amount increased from the previous year decreased less from the previous year at landing ports in Hokkaido.

The relationship between landing amounts (Q) and wholesale prices (P) of fresh salmon in Hokkaido from 1978 to 2000 was shown as follows: P=1233-0.0228Q, P (yen per kg), Q (tons), r^2=0.896, $p<0.001$. It was found that the average wholesale price was slightly less than 300 yen per kg when the landing amount exceeded 40,000 tons at seven main landing ports in Hokkaido (Fig. 4). It became clear that the wholesale price of fresh salmon fell when the amount (the quantity of supply) of landed fresh salmon increased, and the wholesale price rose when the quantity of supply decreased. In other

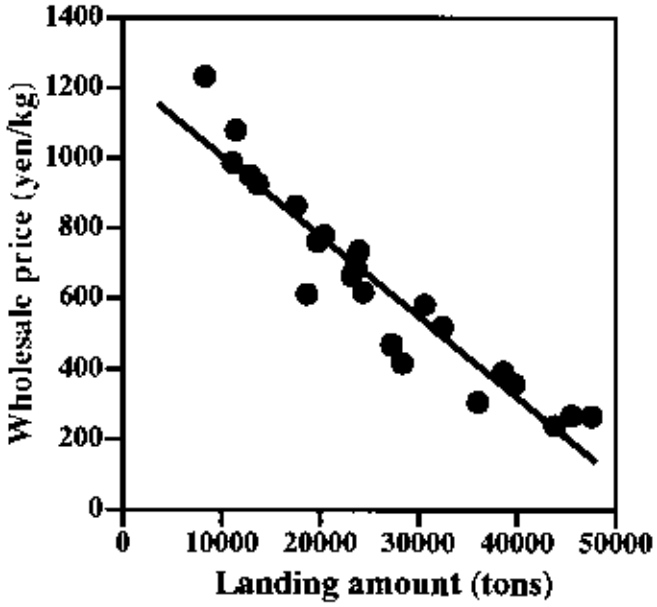

Fig. 4. Relation between landing amount and wholesale price of fresh salmon at the main landing ports in Hokkaido from 1978 to 2000. Main landing ports were Mombetsu, Abashiri, Nemuro, Kushiro, Hiroo, Hakodate and Otaru.

words, the demand for fresh salmon at landing ports is generally fixed.

Causality among economic factors surrounding domestic salmon in Japan

The causality among economic parameters surrounding domestic salmon and import salmon was measured by using the Granger Test of EViews. Fresh "Sake" (PF), salted "Sake" (PS), fresh "Masu" (PM) and import salmon (PI) were used as the parameter for the price. Fresh "Sake" (QF), salted "Sake" (QS), fresh "Masu" (QM) and import salmon (QI) were used as the parameter for the production amount. Frozen "Sake" (ZF), salted "Sake" (ZS) and salted salmon roe (ZE) were used as the parameter for the inventoried amount. Private final consumer expenditure (C) was used as the parameter of income. It was divided in two periods and measured. Most imported salmon was wild salmon, mainly sockeye salmon imported from the United States between 1975 and 1992. On the other hand, most imported salmon was farmed salmon imported from Chile and Norway between 1988 and 2001. As a result, the causality measured by the Granger test became clear (Fig. 5). The production amount of fresh "Sake" influenced the amount of imported fresh salmon, the price of imported fresh salmon and the price of salted "Sake" from 1975 to 1992. However, there was not a clear relation between the production amount of fresh "Sake" and the amount or price of imported fresh salmon from 1988 to 2001.

The economic parameters were analyzed by the TSP (Time Series Processor) econometric method to clarify the change factor in the wholesale price of fresh salmon in Japan between 1975 and 2001. It was divided in two periods, 1975 to 1992 and 1988 to 2001, based on the difference in the amount of imported wild salmon or imported farmed salmon. The parameters used by the TSP method were the same as ones of the Granger Test. OLS (Ordinary Least Squares) or ML (Maximum Likelihood) was used as the method of estimation. The factors established the following correlation in the estimated wholesale prices of fresh "Sake". The value in parenthesis is t-statistic and ***, **, * shows the level of significance, 1%, 5%, 10%, respectively.

From 1975 to 1992:

$$\ln PF = -14.64 - 0.610 \ln QF - 0.609 \ln ZE + 0.992 \ln C$$
$$(-1.11)(-2.14)^{*} \quad (-2.85)^{**} \quad (2.23)^{*}$$

$Adj R^2$ (Adjusted R-squared)=0.847, DW (Durbin-Watson statistic)=2.09, s (Standard error of regression)=0.09, by OLS.

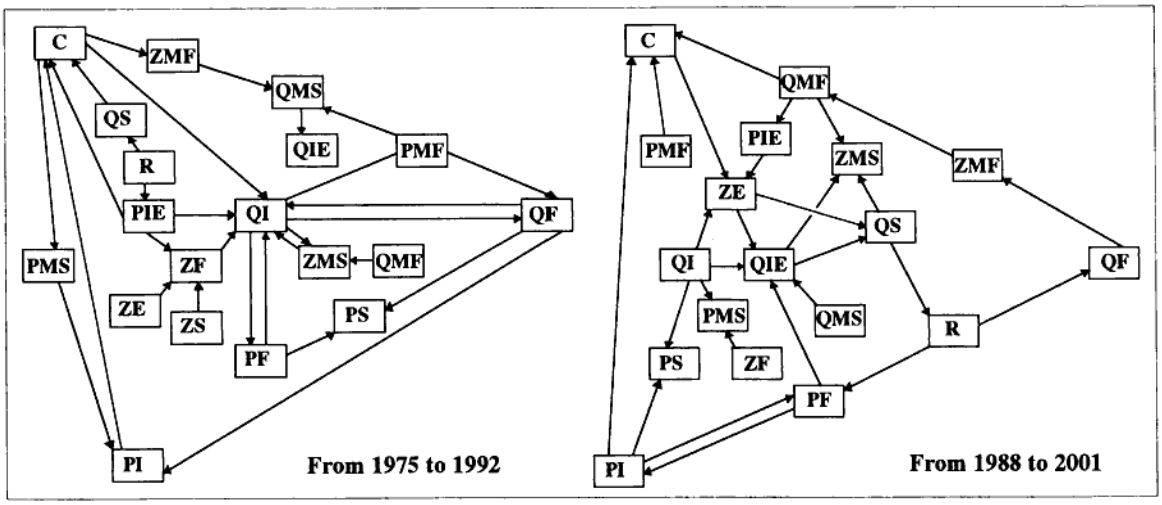

Fig. 5. Causality of economic parameters surrounding domestic salmon and import salmon in two periods, 1975 to 1992 and 1988 to 2001. Most imported salmon was wild salmon from 1975 to 1992 and was cultured salmon from 1988 to 2001. A parameter of a wholesale price of fresh "Sake", salted "Sake", fresh "Masu" and salted "Masu" was PF, PS, PMF and PMS, respectively. A parameter of fisheries production of fresh "Sake", salted "Sake", fresh "Masu" and salted "Masu" was QF, QS, QMF and QMS, respectively. A parameter of inventory amount in the end of December of frozen "Sake", salted "Sake", frozen "Masu", salted "Masu" and salted salmon roe was ZF, ZS, ZMF, ZMS and ZE, respectively. A parameter of an import price of salmon and salted salmon roe was PI and PIE, respectively. A parameter of an amount of import salmon and import salted salmon roe was QI and QIE, respectively. A parameter of private final consumption expenditure and exchange rate was C and R, respectively.

From 1988 to 2001:

$$\ln PF = 112.28 - 0.754 \ln QF - 0.705 \ln ZE - 2.75 \ln C$$
$$(3.53)^{***} \quad (-3.52)^{***} \quad (-2.90)^{**} \quad (-2.80)^{**}$$

$Adj R^2 = 0.941$, DW=1.82, s=0.10, by OLS.

It was clarified that wholesale prices of fresh salmon were established not only by the landing amounts of fresh salmon, but also by the amounts of inventoried salted salmon roe. The factor established the next correlation in the estimated amounts of imported salmon.

From 1988 to 2001:

$$\ln QI = 21.08 - 0.825 \ln PI - 0.319 \ln ZF$$
$$(10.18)^{***} \quad (-10.53)^{***} \quad (-2.17)^{**}$$

$Adj R^2 = 0.880$, DW=2.23, Rho (Autocorrelation coefficient)=-0.49, by ML.

It was clarified that the amounts of imported salmon were established by the import prices of salmon and the amounts of inventoried frozen salmon, and the amount of imported salmon decreased not only with a rise in the import prices of salmon, but also with an increase in the amount of inventoried frozen salmon.

Discussion

Structural factors on long-term changes in supply and demand, and short-term changes in wholesale prices of salmon

The demand for salmon has been large, and salmon has had a stable position as main fishery product in Japan. Comparing the annual consumption per person of salted salmon and fresh salmon in Japan, salted salmon accounted for 80% of the salmon consumed between 1979 and 1985. However, the consumption of fresh salmon increased rapidly after 1989 and the consumption of fresh salmon and salted salmon became almost equal in 1994. Since then, the consumption of fresh salmon has increased more than that of salted salmon (Shimizu 2001). The rapid increase in the amount of imported salmon was accompanied by development of a strong yen, a reduction of offshore fishery in the North Pacific Ocean, and pressure to expand the market by the United States and Canada (Ono 1999). At the same time, a tendency for the amount of imported salmon to increase was strengthened because the consumption in Japan changed from salted salmon into fresh salmon (Hiroyoshi 1989).

The total supply amount (fishery production and import amount) of salmon has recently been more than about 500,000 tons a year, and has come to exceed greatly the amount consumed. The inventory amount of salmon has been close to 100,000 tons since 1994. It is necessary to increase the amount of salmon consumed domestically and the amount of exported salmon to expand the demand for salmon. Domestic salmon prices are determined by the inventory amount, the import amount and the current production amount by salmon set net fishery. The wholesale prices of domestic salmon were influenced by the prices of imported salmon (Taya 1991).

I thought that the phenomenon caused by short-term changes in the wholesale price of fresh salmon was repeated by long-term changes and led to a fall in the wholesale price. Because the amount of imported fresh salmon in Japan and the wholesale price of fresh salmon in Hokkaido showed a negative correlation, it became clear that the wholesale price was influenced negatively by the amount of imports. In other wards, the wholesale price of fresh salmon throughout Hokkaido showed long-term changes as a result of increases in the amount of imports, and the wholesale price of fresh salmon at landing ports showed short-term changes as a result of the landing amounts (Shimizu 2002).

Effects of inventoried and import salmon on the wholesale price of fresh salmon in Japan

The wholesale prices of fresh "Sake", salted "Sake", fresh "Masu" and salted "Masu" showed a tendency to increase in the latter half of the 1970s in Japan. Most "Sake" is chum salmon and most "Masu" is pink salmon in Japan. The wholesale price of salted "Sake" increased rapidly from 1,600 yen per kg in 1975 to 2,500 yen per kg in 1978. However, the wholesale prices of salmon, including salted "Sake", showed a tendency to fall after 1978. The influence of the landing amount of salmon by mother ship fishery in the North Pacific Ocean resulted in an increase in the wholesale price of salted "Sake" before 1978. The remarkable rise in wholesale prices before 1978 was caused by the rise in commodity prices due to the oil crisis and the deficiency of supply due to the 200-mile regulation. On the other hand, salmon fishery production declined in the North Pacific Ocean and the landing amount of salmon decreased, and the wholesale prices of salmon continued to decrease as a result. The Japanese economy was in the low-growth phase after the oil shock in 1973, and the standard level of con-

sumption in Japan slumped. An increase in the amount of imported salmon was attempted to correct the disparity of fishery production in the northern seas and domestic demand (Ono 1999). The amount of domestic supply has increased due to the increase in the landing amount of domestic salmon with a success of artificial salmon enhancement. The wholesale price of salmon has decreased and the consumption of salmon per person showed a slight increase (Shimizu 2001).

Most imported salmon was wild salmon from the United States from 1975 to 1992, and farmed salmon from Chile and Norway from 1988 to 2001. The price of fresh "Sake" and the amount of imported salmon mutually influenced each other, and the amount of import salmon was influenced by the amount of inventoried frozen "Sake" between 1975 and 1992. There was no relation between the price of fresh "Sake" and the price of import salmon in the period as well as the report of Tada (2000). On the other hand, the price of fresh "Sake" and the price of imported salmon gave influence mutually between 1988 and 2001. The amount of inventoried salted salmon roe was influenced by the amount of imported salmon. However, the production amount of fresh "Sake" was not influenced by the amount of imported salmon in that period. I thought that it was because the supply of imported salmon had exceeded the demand between 1988 and 2001.

As a result of the econometric analysis of wholesale prices, it was clarified that the wholesale price function of fresh salmon was influenced by the amounts of inventoried frozen salmon and salted salmon roe. The amounts of inventoried frozen salmon were established by determining the increase in the landing amounts over the previous year between 1975 and 1992. They were affected by the import amounts in the previous year between 1988 and 2001. Comparing the amounts of inventoried frozen salmon in the end of December with those in the end of March, the decrease in the inventoried amount in the end of March was larger before 1998 (Fig. 6). But the inventoried amount in the end of March increased larger than those in the end of December after 1999. I thought that the large seasonal variation of inventoried amounts in recent years was due to the difference in the change of the amount of imported fresh salmon in winter.

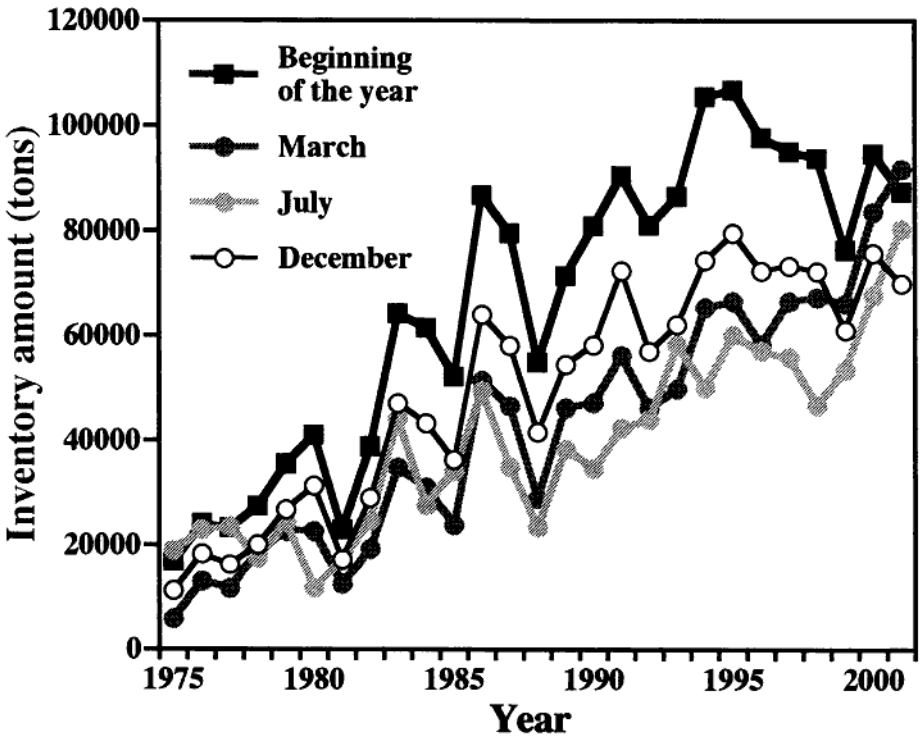

Fig. 6. Annual variations in the inventory amounts of frozen salmon in the beginning of the year, the ends of March, July and December from 1975 to 2001. The inventory amounts in the beginning of the years were estimated by dividing 0.8 into the inventory amounts in the end of December in the previous years, because inventory amounts were accumulated values until eighty percent of freezing and cold storage capacity.

The relationships between the amounts of inventoried frozen salmon (ZF), the fishery production of fresh salmon in the previous year ($QF^{\#}$), the amounts of imported fresh salmon in the previous year ($QI^{\#}$), the wholesale price of fresh salmon in the previous year ($PF^{\#}$) and the exchange rate (R) were analyzed to clarify the effect of the amount of inventoried frozen salmon.

From 1975 to 1992:

$$\ln ZF = 4.57 + 0.459\ln(QF^{\#}) + 0.210\ln(QI^{\#}) - 0.169\ln(PF^{\#})$$
$$(0.55)\quad (1.01)\quad (3.08)^{**}\quad (-0.31)$$

$Adj R^2 = 0.825$, DW=1.64, s=0.21, by OLS.

From 1988 to 2001:

$$\ln ZF = -3.18 + 0.563(QF^{\#}) + 0.525\ln(QI^{\#}) + 0.255\ln(PF^{\#})$$
$$(-0.98)\quad (3.50)^{***}\quad (4.03)^{***}\quad (2.68)^{**}$$

$Adj R^2 = 0.710$, DW=1.99, s=0.06, by OLS.

From 1975 to 1992, the effect of the fishery production in the previous year on the amount of inventoried salmon was larger than that of wholesale prices in the previous year. On the other hand, the effect of the amount of the imported salmon in the previous years from 1988 to 2001 was greater than the effect from 1975 to 1992.

The amounts of imported fresh salmon have shifted from wild salmon to farmed salmon recently, and farmed salmon have been imported in the winter season when wild salmon cannot be imported. Wild salmon were imported from the United States and Russia in summer (from July to September) and farmed salmon from Chile were imported in winter. The countries from which fresh salmon were imported differed according to the season (Fig. 7).

On the other hand, the import of farmed salmon from Norway has not been concentrated in a specific season, and the amounts of salmon imported from Chile have increased remarkably in the winter. Fresh salmon were imported from summer to autumn in the first half of the 1990s, when wild salmon were mainly imported. The percentages of farmed salmon and wild salmon in the imported fresh salmon in 1995 were 8.1% and 85.3%, respectively. But fresh salmon was imported from winter to spring in recent years, when farmed salmon were mainly imported. The percentages of farmed salmon and wild salmon in the imported fresh salmon in 2001 were 72.1% and 23.7%, respectively. The price of farmed salmon imported from winter to spring went ahead, and a price system of fresh salmon was formed (Fig. 8).

The inventoried amounts were adjusted in winter season, the off-fishing season for salmon supply. Because farmed salmon were imported in winter and the supply of fresh salmon became excessive, the consumption of inventoried amounts slowed down (Shimizu 2004). It is necessary to take countermea-

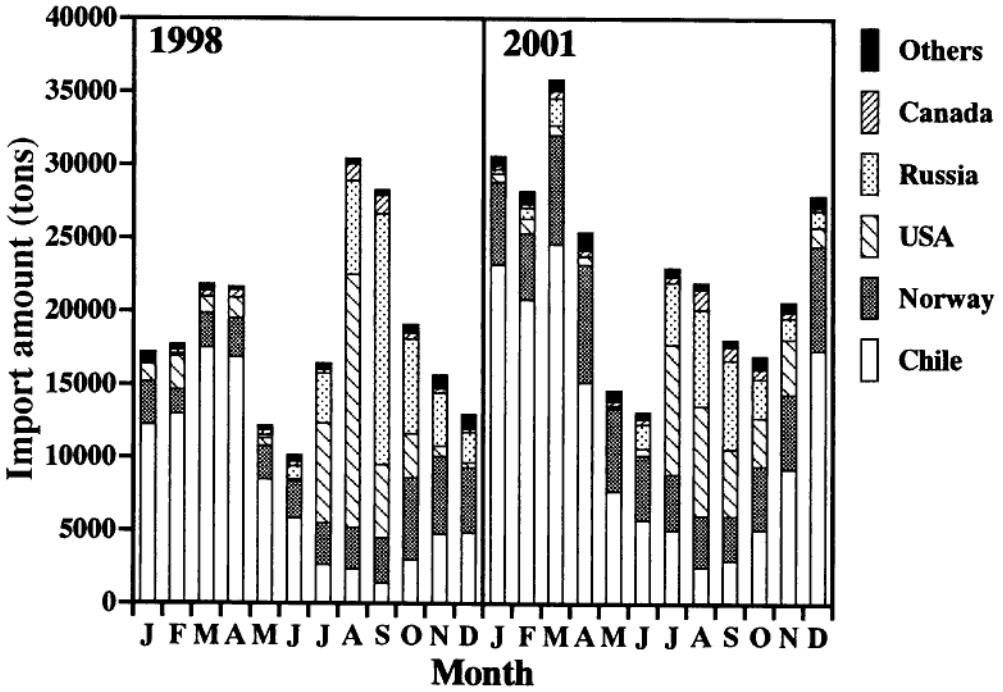

Fig. 7. Monthly variations in the amounts of imported fresh salmon from main countries in 1998 and 2001.

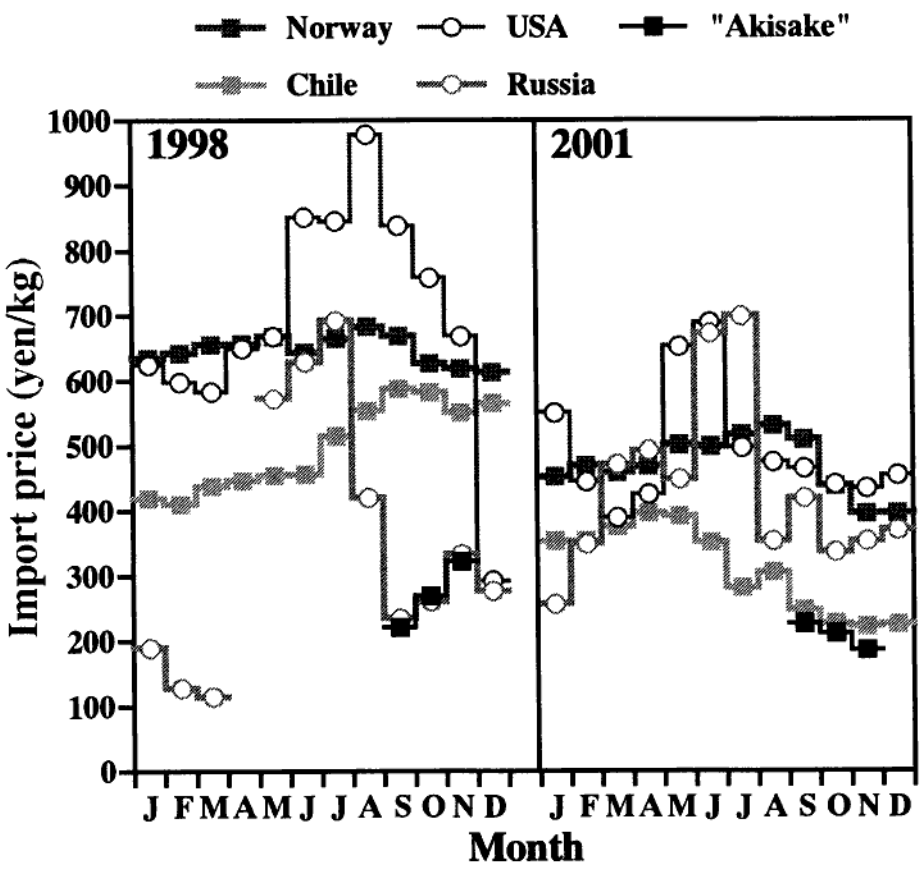

Fig. 8. Monthly variations in the price of imported fresh salmon from main countries and "Akisake" in 1998 and 2001. "Akisake" are matured chum salmon caught by set net fishery in autumn in Hokkaido.

sures to reduce the year-end inventoried amounts, because the wholesale prices of autumn salmon have been low with the increase of returned salmon resources. The slump in wholesale prices leads to a reduction in the number of fisherman and in fishery production.

Though there is high consumption of salmon in the northern and eastern part of Japan, it may be possible to increase consumption in the western part of Japan. It has been suggested that freshness, commodity-making, development of new markets for consumers, and ensuring food safety are important factors to ensure the stability of wholesale prices and to increase the demand for domestic salmon. The wholesale price in the landing area is the first principle of income formation for fishery producers (Ietsune 1996). An analysis of the tendency in the demand for salmon and a grasp of consumer needs are important to enhance the production of salmon.

In conclusion, the wholesale prices of fresh salmon throughout Hokkaido showed long-term changes due to the influence of the increase in the amount of imported salmon, and the wholesale price of fresh salmon at landing ports showed short-term changes due to the influence of the landing amounts. A large seasonal variation in the amounts of inventoried salmon in recent years was due to the difference in the pattern of imported fresh salmon in winter. The amounts of imported fresh salmon have shifted from wild salmon to farmed salmon recently. Farmed salmon have been imported in winter, when wild salmon could not be imported. The price of farmed salmon imported in winter rose, and a price system for fresh salmon was formed in Japan. Freshness, commodity-making, development of new markets for consumer and ensuring food safety will be important to ensure the stability of wholesale prices and to increase the demand for domestic salmon. An analysis of the tendency of the demand for salmon and a grasp of consumer needs are important to enhance the production of salmon.

Acknowledgements

I wish to acknowledge valuable discussions on econometric analysis with Dr. Masahiko Ariji of UFJ Institute Ltd. and Dr. Minoru Tada of the Japan International Research Center for Agricultural Sciences. I appreciate the help received from Mr. Naoyuki Tao and Mr. James Colyn of the Fisheries Cooperatives Management Center Co. Ltd. with the correlation of this manuscript.

References

Ariji, M. 2000. A study about fish market transform ation in Japan - market analysis by simultaneous equation models approach for fish market in Japan. J. Reg. Fish., 40: 43-60.

Hiroyoshi, K. 1989. Problems and prospect on the trade of fishery products in contemporary Japan. Jap. J. Fish. Econo., 34: 44-70.

Ietsune, T. 1996. Demand and supply of fishery products in the health intention times. Nourintoukei-chousa, 7: 36-41.

Matsuura, K. and C. Mckenzie. 2001. Econometric analysis by EViews. Toyokeizai-shinposha, Tokyo. 409 p.

Minotani, C. T. Nomura, T. Saito and T. Ohtsu. 1997. A quantity analysis by a personal computer. Taga-shuppan, Tokyo. 339 p.

Nakai, A. 1988. Structural variety of Japanese fisheries in the North Pacific Ocean. Seizando-shoten, Tokyo. 391 p.

Nawada, K. 1997. A guide of econometric analysis by TSP. Asakura-shoten, Tokyo. 167 p.

Ono, S. 1999. Fisheries economics under the 200 miles system; trace and focus to study. Nourintoukei-kyokai, Tokyo. 341 p.

Shimizu, I. 2001. Structural factors on changes in supply and demand of salmon in Japan. Bull. National Salmon Resources Center, 4: 19-29.

Shimizu, I. 2002. Factors on short- and long- term changed in wholesale prices of salmon in Hokkaido. Bull. National Salmon Resources Center, 5: 13-19.

Shimizu, I. 2004. Effects of import and inventory amounts of salmon on wholesale price function of fresh salmon in Japan. Bull. National Salmon Resources Center, 6: 1-11.

Shirasago, T. 1998. Econometrics. Nihonhyoronsha, Tokyo. 277 p.

Tada, M. 2000. International synchronization of prices of fishery products of Japan. Noringyomondaikenkyu, 35: 136-139.

Takigawa, Y. and H. Maeda. 2004. A guide of econometrics by EViews. Nihonhyoronsha. Tokyo. 191 p.

Taya, K. 1988. Salmon market and its price function. Jap. J. Fish. Econo., 33: 23-46.

Taya, K. 1991. Fishery products market in the globalization times; demand and supply of fishery products and price formation. Hokuto-shobou, Tokyo. 247 p.

日本のサケ漁業を取り巻く経済要因の影響

清水幾太郎

わが国の沖合サケ漁業は衰退したが，国産シロザケの生産量はふ化放流事業の成功によって年々増加してきた．しかし，サケ市場が国際化したことによって国産シロザケの産地価格は低迷し続け，わが国のサケ漁業は存続の危機に直面し構造改革を迫られている．国産シロザケの価格変動要因を明らかにするために，北海道の水揚げ港におけるシロザケ価格の短期および長期の変動機構並びに産地市場におけるシロザケの価格形成要因を計量的に分析した．生鮮サケ類産地価格は生鮮サケ類在庫量と生鮮サケマス類輸入量が増加すると低下し，塩蔵サケ卵と生鮮サケ類の在庫量が増加すると下落した．近年，輸入サケマス類の主体が天然サケ類から養殖サケマス類にシフトし，さらに養殖サケマス類の輸入量が冬期間に増加してきたため生鮮サケ類の在庫量が増加した．この結果から生鮮サケ類の産地価格に対する在庫量の影響が明らかになった．在庫量を減らし産地価格を安定させるためには鮮度保持，新商品開発，安全性維持によって国産シロザケ市場の拡大を図る必要がある．このためにはシロザケに対する消費者嗜好の分析とニーズの把握が漁協やサケ資源の増殖機関などの供給側にとって重要である．