Effects of Economic Factors surrounding Salmon Resources of Japan

by

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ABSTRACT

Japanese salmon fishery is facing a juncture of existence and pressed for the improvement of constitution. The decline of high seas salmon fisheries was taken and the import amount increased rapidly. In addition, domestic production by coastal set net fisheries has increased with a success of salmon enhancement in Japan. Salmon market has internationalized consequently, decreasing wholesale prices of domestic salmon in Japan. Factors on short-term and long-term changes in the wholesale prices of salmon at the main landing ports in Hokkaido were examined to clear the cause of variability of wholesale prices of domestic salmon. The wholesale price increased in the year when the landing amount of salmon decreased from the previous year. A negative correlation between the landing amount and prices of salmon at the landing ports indicated that the prices of salmon were influenced by the landing amount. It was also clarified that the import amount of salmon influenced the wholesale price of salmon. The wholesale price of salmon in the entire Hokkaido showed the long-term variability depending on the amount of imported salmon, and the wholesale price of salmon in the regions showed the short-term variability depending on the amount of landing salmon. Factors on wholesale price function of salmon in Japan were analyzed by econometric method. It was clarified that wholesale price of fresh salmon decreased when inventory amount of fresh-cold salmon or import amount of fresh salmon increased and wholesale price of fresh salmon also decreased when inventory amount of salted salmon roe and fishery production of fresh salmon increased. Increase in the inventory amount of fresh salmon in recent years was caused because of increase in the import amount of fresh salmon produced by aquaculture in winter. It is necessary to magnify the demand of domestic salmon to reduce inventory amount. Freshness, commodity-making, development of new markets for consumer and conservation of food safety will be important for the stability of wholesale prices and demand expansion of domestic salmon. Furthermore, analysis of a demand trend of salmon and grasp of consumer needs are important for the supply side that shoulders enhancement production and fishery production of salmon.

Keywords: salmon, wholesale price, import price, landing amount, import amount, inventory amount, econometric analysis

INTRODUCTION

Japanese salmon fishery is facing a juncture of existence and pressed for the improvement of constitution. Fishery production of matured salmon returned coastal area increased rapidly in 1980's in the northern part of Japan. On the other hand, wholesale price of domestic salmon showed a peak in 1978. It fell afterwards and decreased a one-third in a peak recently. If the decrease of wholesale price of salmon depends on a factor of economic structure surrounding salmon fishery, it is necessary to change in production structure corresponding to economic environment. Therefore, it is important to investigate economic appearance related to salmon fishery, particularly a supply and demand trend of domestic salmon. It was elucidated that a trend of domestic production amount and import amount as a supply side of salmon, and a trend of domestic consumption and a characteristic of foreign demand (export amount) as a demand side of salmon to survey relationship between internal salmon production and consumption in Japan. I considered the change of structure to be found in a change of demand and supply is a basic frame decided a market price of salmon in Japan.

The recent years are the severe age for salmon set net fishery because the difference between an income and management expense of set net fishery has reduced by the decrease of wholesale price. What kind of cause will bring about a slump in wholesale price of autumn salmon? In the latter half of 1980's the import amount of salmon was increasing rapidly and the wholesale price of domestic salmon was sluggish by competition with the import salmon. Has the import price of salmon influenced the changes in wholesale prices of domestic salmon? Thus changes of average prices of domestic salmon at the landing ports in Hokkaido were investigated and factors on short-term and long-term changes in wholesale prices of salmon.

What kind of relation between landing amount of domestic salmon and import amount of salmon have influenced wholesale prices of domestic salmon? It has not been discussed whether the formation of wholesale prices had some kinds of relation to change of landing amount, import amount and inventory amount. A wholesale price of salmon was established not only by landing amount but also by inventory amount of the beginning of the year (Taya 1988). The observation period between 1979 and 1986 by Taya was the age when wild salmon predominated in import amount of fresh salmon and different from recent years. Therefore, the causality among landing amount, import amount and inventory amount surrounding import salmon and domestic salmon was clarified by econometric analysis on long-term changes of wholesale prices of fresh salmon in Japan.

METHODS

The data of wholesale prices, landing amounts, inventory amounts, fishery production of salmon and private final consumption expenditure were used from the annual reports between 1965 and 2001 of the Ministry of Agricultural, Forestry and Fisheries of Japan. The data of import amounts, import prices and export amounts were used from the import and export trade statistics of the Ministry of Finance of Japan. The wholesale prices of autumn salmon of Japan were used from the annual report of the Set Net Fishery Association of Hokkaido. The prices were deflated by the

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consumer price index of the Statistics Bureau of Japan. In the domestic salmon captured in autumn season in Japan, a main fish what is called "Sake" is chum salmon (*Oncorhynchus keta*) and a main fish what is called "Masu" is pink salmon (*O. gorbuscha*). Imported salmon includes sockeye salmon (*O. nerka*), Atlantic salmon (*Salmo salar*), trout (*O. mykiss* and *S. trutta, etc.*), coho salmon (*O. kisutch*) and other.

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

The causality of these economic parameters was measured to clear 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 (Ariji 2000). $\ln P = e_0 + e_1 \ln Q + e_2 \ln Z + e_3 \ln C$, P=wholesale price, Q=landing amount, Z=inventory amount and C=national income. Values of elasticity (e_n) were estimated by the econometric method of TSP/Give Win 4.5 (TSP International) (Nawada 1997, Minotani etc. 1997 and Shirasago 1998).

RESULTS AND DISCCUSION

Structural Factors on Changes in the Supply and Demand of Salmon in Japan

The percentage of the domestic production amount of salmon accounts in the whole fishery production in Japan was only 1.5% until the first half of 1980's. The domestic production amount of salmon increased rapidly from the latter half of 1980's and that percentage reached 5% of the whole fishery production currently. While the whole fishery production amount was in a reduction tendency, the domestic production amount of salmon showed an increase tendency. The percentage of the fishery production amount by mother ship fishery and drift net fishery toward the domestic production amount of salmon in Japan was accounting about 50% 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 the production by salmon set net fishery less than 50% before 1977 and it was over 70% in 1984. Compared with annual production amount of salmon by set net fishery and by other fishery except set net, 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 level afterwards. Though the amount by set net fishery was 20,000-40,000 tons until 1974, more than 100,000 tons after 1983 and reached 150,000 tons in 1989. Furthermore, the production amount of salmon by set net fishery increased in 230,000 tons in 1997 and the percentage accounted in the domestic production amount reached 86% (Figure 1).

The household consumption of salmon increased from 1977 to 1982 and the import amount

of fresh and frozen salmon increased rapidly. But the export amount of salmon decreased after the latter half of 1970's. The annual import amount of salmon was 50,000 tons in the first half of 1980's and it increased rapidly afterward. The annual import amount of salmon reached about 250,000 tons at the peak of the first half of 1990's. It changed by 210,000-230,000 tons in the latter half of 1990's. In the background where the import amount of salmon increased rapidly, there were development of a strong yen, reduction of offshore fishery in the North Pacific Ocean and pressure to market expansion by America and Canada (Ono 1999). The import amount of salmon in 1999 was Chile (74,000 tons), Norway (67,000 tons), America (54,000 tons), Russia (25,000 tons) and Canada (7,000 tons) by 238,000 tons (134,000 million yen). The import amount of salmon from Chile and Norway accounted 59% (63% by money) in the whole import amount of salmon. Though the increase tendency of import amount of salmon from Chile slowed down a little and the import amount of salmon from America decreased, the import amount from Norway increased rapidly in this several years (Figure 2).

Furthermore, an increase tendency of import amount of salmon was strengthened because consuming structure in Japan changed into fresh salmon from salted one (Hiroyoshi 1989). The demand amount of salmon has been large and salmon has had a stable position in main fishery products in Japan. Compared annual consumption per a person with salted salmon and fresh salmon in Japan, salted salmon accounted 80% of the consumption of salmon 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. Afterward the consumption of fresh salmon has increased than one of salted salmon.

Total supply amount (fishery production and import amount) of salmon has been more than about 500,000 tons a year recently and has come to exceed consumption amount greatly. Inventory amount of salmon has been near 100,000 tons after 1994. It is necessary to make increase the internal consumption and the export amount for the expansion of demand of 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 prices of imported salmon (Taya 1991). Though there is a lot of consumption of salmon in the northern and eastern part of Japan, there may be a capability of demand expansion in the western part of Japan. It was suggested that freshness, commodity-making, development of new markets for consumer and conservation of food safety will be important for the stability of wholesale prices and demand expansion of domestic salmon (Shimizu 2001).

Factors on Short- and Long- Term Changes in Wholesale Prices of Salmon in Hokkaido
Because chum salmon (*O. keta*) was a main fish in the products caught with salmon set nets, the change of wholesale prices of salmon was examined by average prices of fishery products with set nets. While the non-set net fishery whose main fishery was a mother ship fishery declined by the problem of 200 miles fishery zone, an exchange rate of yen for dollar changed in 103 yen of 1994 from 237 yen of 1984. Because a price of salmon produced in foreign countries decreased relatively by a strong yen, an import amount of fresh salmon increased rapidly. The relationship between import amount (I) of fresh salmon in Japan and average prices (P) of fresh salmon in Hokkaido from 1978 to 2000 was shown at the following correlation. P=1200-0.00375I, P (yen per kg), I (tons), r^2=0.798, p<0.001. In addition, the relationship between import prices (IP) of fresh

salmon in Japan and average prices (P) of fresh salmon in Hokkaido from 1978 to 2000 was shown at the following correlation. P=1.173IP-268, IP (yen per kg), P (yen per kg), r^2=0.754, p<0.001.

The following tendency was shown in the relationship between fishery production amount of salmon with set nets and average prices of salmon. An average price increased in the year when the fishery production amount decreased less than the previous year and an average price decreased in the year when the fishery production amount increased more than last year. Also the following tendency was shown in the relationship between landing amounts of fresh salmon and wholesale prices at the landing ports in Hokkaido. Though a wholesale price in the year when the landing amount decreased less than the previous year increased more than the previous year, a wholesale price in the year when the landing amount increased more than the previous year decreased less than the previous year at the landing ports in Hokkaido. It became clear that a wholesale price of fresh salmon fell down when a landing amount (a quantity of supply) of fresh salmon increased and a wholesale price rose when a quantity of supply decreased. In other words, the demand of fresh salmon at landing ports means to be about fixed.

From the relationship between landing amounts and wholesale prices in Hokkaido, it was found out that an average wholesale price around less than 300 yen per kg when a landing amount exceeded 4,000 tons at seven main landing ports in Hokkaido. I thought that a phenomenon caused in short-term changes of wholesale prices of fresh salmon was repeated in long-term changes and led to down of wholesale prices. Because import amounts of fresh salmon in Japan and wholesale prices of fresh salmon in Hokkaido showed negative correlation, it became clear that wholesale prices were down by influence of import amounts. In other wards, wholesale prices of fresh salmon in whole Hokkaido showed long-term changes by influence of increase of import amounts, and wholesale prices of fresh salmon at landing ports showed short-term changes by influence of landing amounts (Shimizu 2002).

Effects of Import and Inventory Amounts of Salmon on Wholesale Prices Function of Fresh Salmon in Japan

The wholesale prices of fresh "Sake", salted "Sake", fresh "Masu" and salted "Masu" showed an increase tendency in the latter half of 1970's in Japan. Most of "Sake" is chum salmon and most of "Masu" is pink salmon (*O. gorbuscha*) in Japan. The wholesale price of salted "Sake" increased rapidly from 1,600 yen per kg to 2,500 yen per kg between 1975 and 1978. However, the wholesale prices of salmon include salted "Sake" showed a fail tendency after 1978. The influence of landing amount of salmon by mother ship fishery in the North Pacific Ocean increased the wholesale price of salted "Sake" before 1978. A remarkable rise of wholesale prices before 1978 was caused by commodity prices made by the oil crisis and the deficiency of supply by 200 miles regulation. On the other hand, salmon fishery production declined in the North Pacific Ocean and landing amount of salmon decreased. Wholesale prices of salmon continued to decrease as a result of that. Japanese economy was in the low growth phase after the oil shock in 1973 and standard level of consumption of Japanese became a slump state. Import expansion of salmon was attempted to correct the disparity of fishery production in the northern seas and domestic demand (Ono 1999). Amount of domestic supply has increased by the rise of a landing amount of domestic salmon due to success of

the artificial salmon enhancement. Though the wholesale price of salmon decreased, the consumption of salmon per a person showed a minute increase tendency (Shimizu 2001).

The causality among economic parameters surrounding domestic salmon and import salmon was measured by using the Granger Test of Eviews. It was divided in two periods and measured. The most of import salmon was wild salmon whose main fish was Sockeye salmon imported from America between 1975 and 1992. On the other hand, the most of import salmon was aquaculture salmon imported from Chile and Norway between 1988 and 2001. As a result, the causality by the meaning of the Granger became clear. A production amount of fresh "Sake" influenced an import amount of fresh salmon, an import price of fresh salmon and a price of salted "Sake" from 1975 to 1992 (Figure 3). A price of fresh "Sake " and an import amount of salmon gave influence mutually and an import amount received influence from an inventory amount of fresh-cold "Sake" in this period. There were no relations between a price of fresh "sake" and a price of import salmon in the period as well as the report of Tada (2000). On the other hand, a price of fresh "Sake" and a price of import salmon gave influence mutually from 1988 to 2001. An inventory amount of salted salmon roe received influence from an import amount of salmon and a production amount of fresh "Sake" did not receive influence from an import amount of salmon in that period.

Economic parameters were analyzed by TSP (Time Series Processor) econometric method to clear a change factor of wholesale prices of fresh salmon in Japan between 1975 and 2001. It was divided in two periods, 1975 to 1992 and 1988 to 2001, from the difference of the number of landing ports. Fresh "Sake" (PF), salted "Sake" (PS), fresh "Masu" (PM) and import salmon (PI) were used as a parameter of a price. Fresh "Sake" (QF), salted "Sake" (QS), fresh "Masu" (QM) and import salmon (QI) were used as a parameter of a production amount. Fresh-cold "Sake" (ZF), salted "Sake" (ZS) and salted salmon roe (ZE) were used as a parameter of an inventory amount. Private final consumer expenditure (C) was used as a parameter of income. OLS (Ordinary least Squares) or ML (Maximum Likelihood) was used as a method of estimation.

The factors established the following correlation estimated wholesale prices of fresh "Sake". A value in parenthesis is t-statistic and ***, **, * shows 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)* (-2.85)** (2.23)*

AdjR^2 (Adjusted R-squared)=0.847, DW (Durbin-Watson statistic)=2.09,

s (Standard error of regression)=0.09, by OLS.

From 1988 to 2001; $\ln PF = 112.28 - 0.754 \ln QF - 0.705 \ln ZE - 2.75 \ln C$

(3.53)*** (-3.52)***(-2.90)** (-2.80)**

AdjR^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 landing amounts of fresh salmon but also by inventory amounts of salted salmon roe. The factor established the next correlation estimated import amounts of salmon.

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From 1988 to 2001; $\ln QI = 21.08 - 0.825 \ln PI - 0.319 \ln ZF$

$$(10.18)*** (-10.53)*** (-2.17)**$$

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

It was clarified that import amounts of salmon were established by import prices of salmon and inventory amounts of fresh-cold salmon, and import amounts of salmon decreased not only by rise of import prices of salmon but also by increase of inventory amounts of fresh-cold salmon.

As a result of econometric analysis of wholesale prices, it was clarified that the wholesale price function of fresh salmon was influenced by inventory amounts of fresh-cold salmon and salted salmon roe. Inventory amounts of fresh-cold salmon were established by landing amounts in the previous year more than import amounts in the previous year between 1975 and 1992. They were affected by import amounts in the previous year between 1988 and 2001. Compared inventory amounts fresh-cold salmon in the end of December with in the end of March, the decrease amount of inventory in the end of March was bigger before 1998 and it was smaller after 1999 (Figure 4). I thought that the big seasonal variation of inventory amounts in recent years was according to the difference of a pattern of import of fresh salmon in winter.

Relationships among inventory amounts of fresh-cold salmon (ZF), fishery production of fresh salmon in previous year ($QF^\#$), import amounts of fresh salmon in previous year ($QI^\#$), wholesale prices of fresh salmon in previous year ($PF^\#$) and exchange rate (R) were analyzed to clear the effect for inventory amounts of fresh-cold salmon.

From 1975 to 1992; $\ln ZF = 4.57 + 0.459 \ln(QF^\#) + 0.210 \ln(QI^\#) - 0.169 \ln(PF^\#)$

$$(0.55)\ (1.01) \qquad (3.08)** \qquad (-0.31)$$

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

From 1988 to 2001; $\ln ZF = 3.18 + 0.563(QF^\#) + 0.525 \ln(QI^\#) + 0.255 \ln(PF^\#)$

$$(-0.98)\ (3.50)*** \quad (4.03)*** \qquad (2.68)**$$

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

The effect of fishery production in previous year for inventory amounts was bigger than one of wholesale prices in previous year from 1975 to1992. On the other hand, the effect of import amounts in previous year from 1988 to 2001 was bigger than the effect from 1975 to 1992.

The import amounts of fresh salmon have turned a shift from wild salmon to cultured salmon recently, and cultured salmon have been imported in the winter season without the chance when wild salmon were imported. Wild salmon were imported from America and Russia in summer (from July to September) and cultured salmon from Chile were imported in winter. The import countries of fresh salmon were different by a season (Figure 5).

On the other hand, the import of cultured salmon from Norway has not been concentrated in specific season and the import amounts from Chile and Norway have increased remarkably in winter. The fresh salmon were imported from summer to autumn at the first half of 1990's when wild salmon were imported mainly. The ratio of cultured salmon and wild salmon in the import

fresh salmon in 1995 was 8.1% and 85.3%, respectively. But the fresh salmon imported from winter to spring in the recent years when cultured salmon were imported mainly. The ratio of cultured salmon and wild salmon in the import fresh salmon in 2001 was 72.1% and 23.7%, respectively. A price of cultured salmon imported between winter and spring went ahead and the price system of fresh salmon was formed (Shimizu 2004).

The inventory amounts were adjusted in winter season when was the off-crop season of salmon supply. Because cultured salmon were imported in winter and supply of fresh salmon became excessive, the consumption of inventory amounts stopped proceeding. It is necessary to make a countermeasure to reduce year-end inventory amounts because wholesale prices of autumn salmon have been sluggish by the increase of returned salmon resources. Slump of wholesale prices leads to reduction of a number of fisherman and fishery productions. Wholesale price in landing area is the first principle of income formation for fishery producers (Ietsune 1996). Analysis of a demand trend of salmon and grasp of consumer needs are important for the supply side that shoulders enhancement production and fishery production of salmon.

CONCLUSION

Wholesale prices of fresh salmon in whole Hokkaido showed long-term changes by influence of increase of import amounts and wholesale prices of fresh salmon at landing ports showed short-term changes by influence of landing amounts. A big seasonal variation of inventory amounts in recent years was according to the difference of a pattern of import of fresh salmon in winter. Import amounts of fresh salmon have turned a shift from wild salmon to cultured salmon recently. Cultured salmon have been imported in winter without the chance when wild salmon were imported. Prices of cultured salmon imported in winter went ahead and the price system of fresh salmon was formed in Japan. Freshness, commodity-making, development of new markets for consumer and conservation of food safety will be important for the stability of wholesale prices and demand expansion of domestic salmon. Analysis of a demand trend of salmon and grasp of consumer needs are important for the supply side that shoulders enhancement production and fishery production of salmon.

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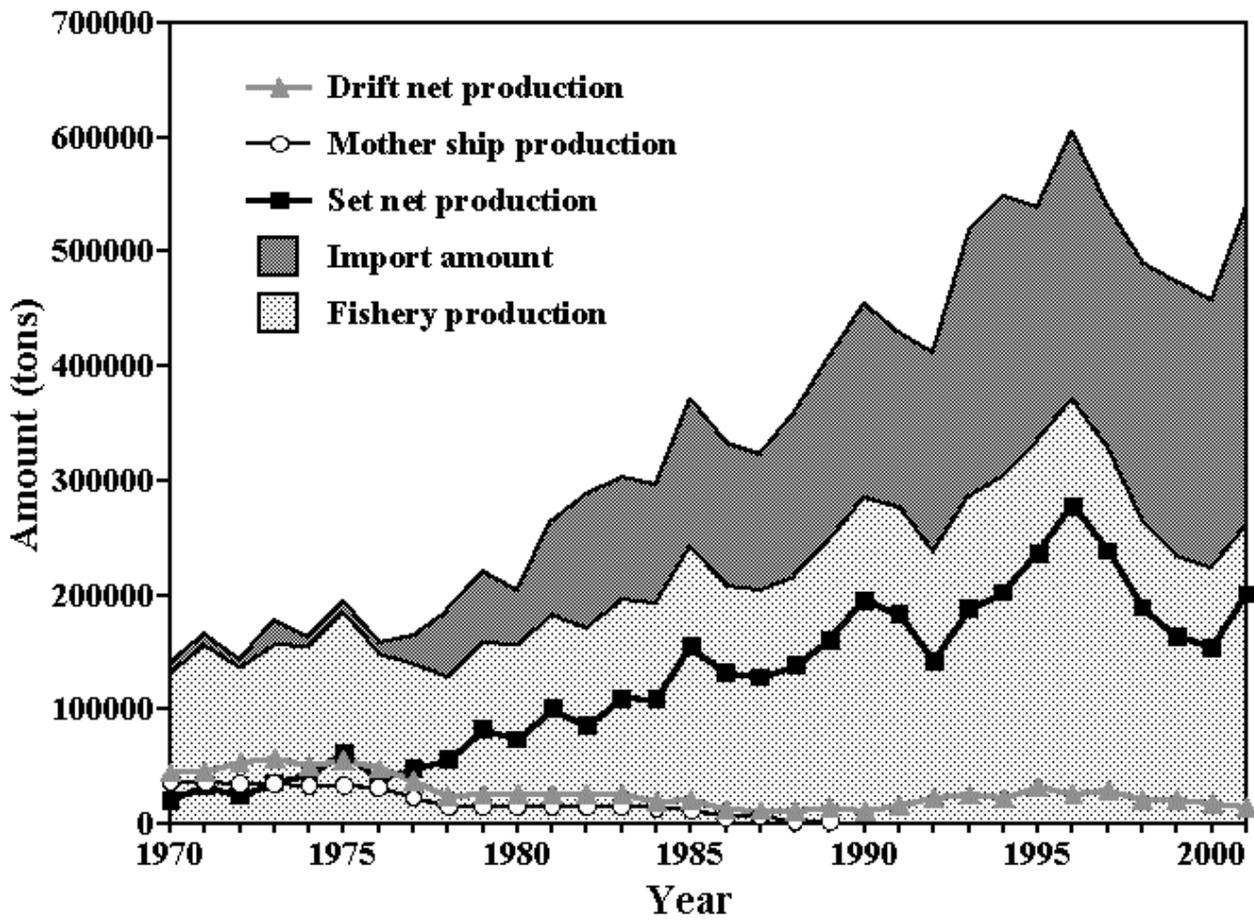
Figure 1. Changes in fishery production and import amount of salmon in Japan from 1970 to 2001.
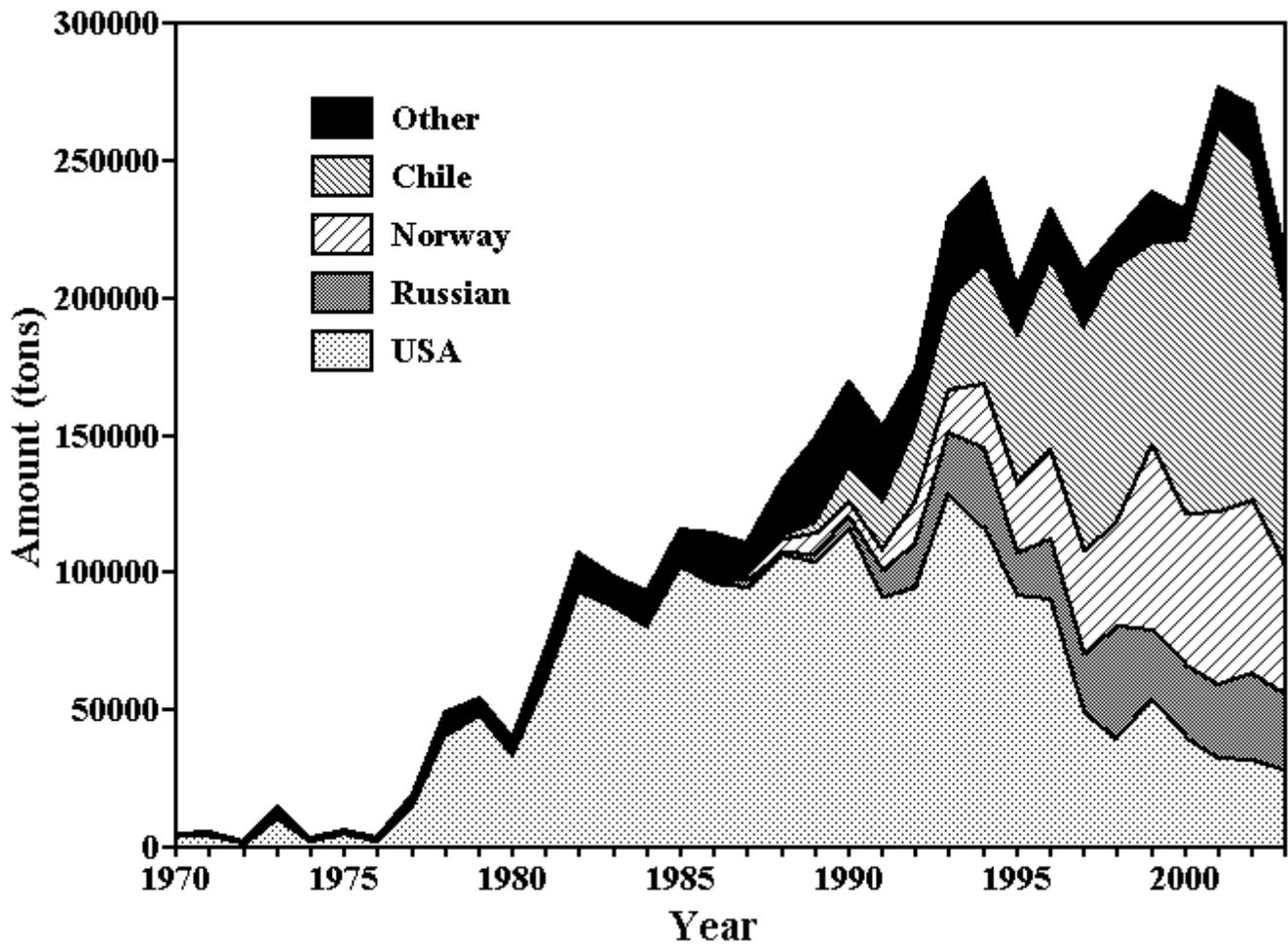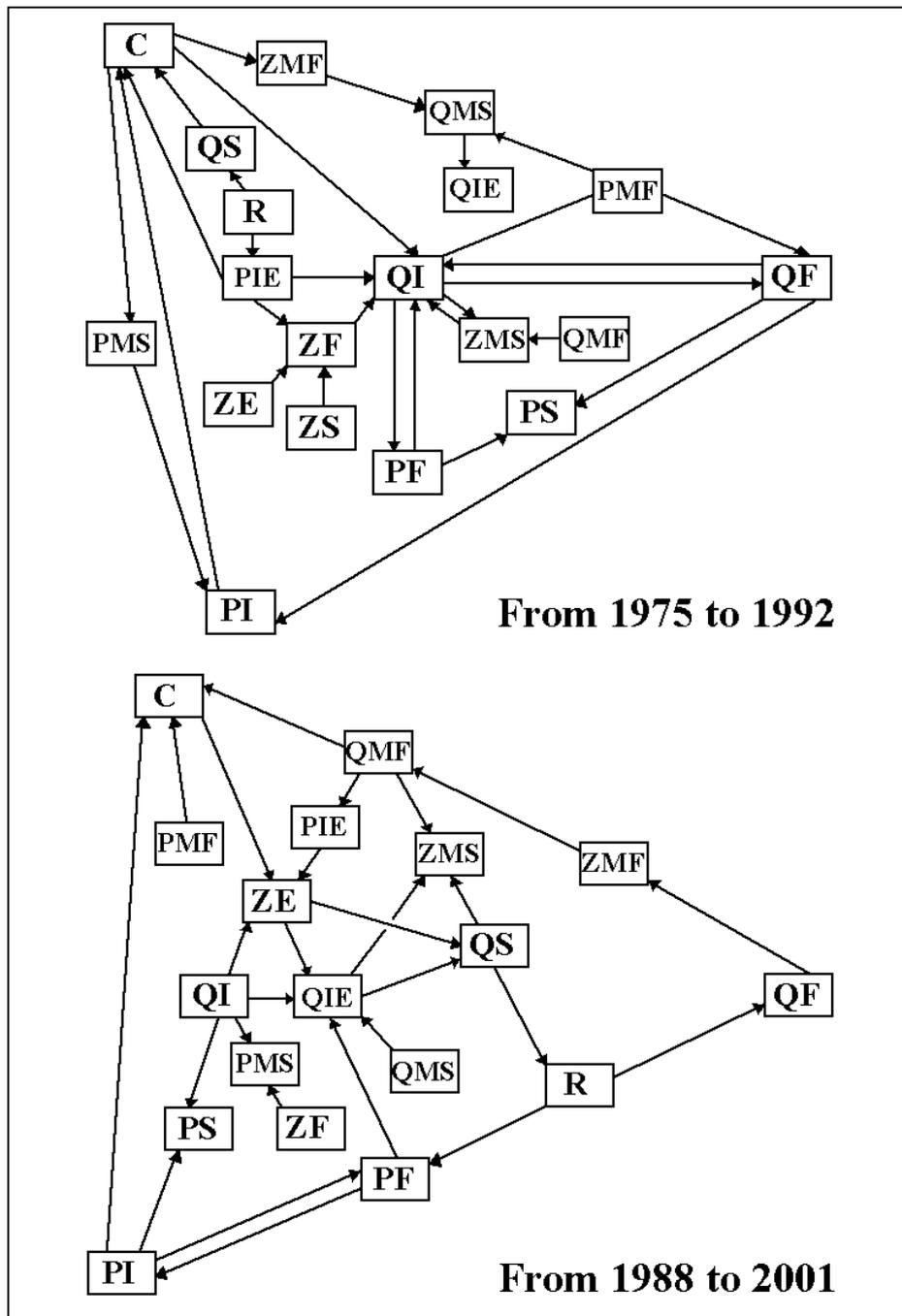
Figure 2. Changes in import amounts of salmon from main countries from 1970 to 2003.

Figure 3. Causality of economic parameters surrounding domestic salmon and import salmon in two periods, 1975 to 1992 and 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 fresh-cold "Sake", salted "Sake", fresh-cold "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 import 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.
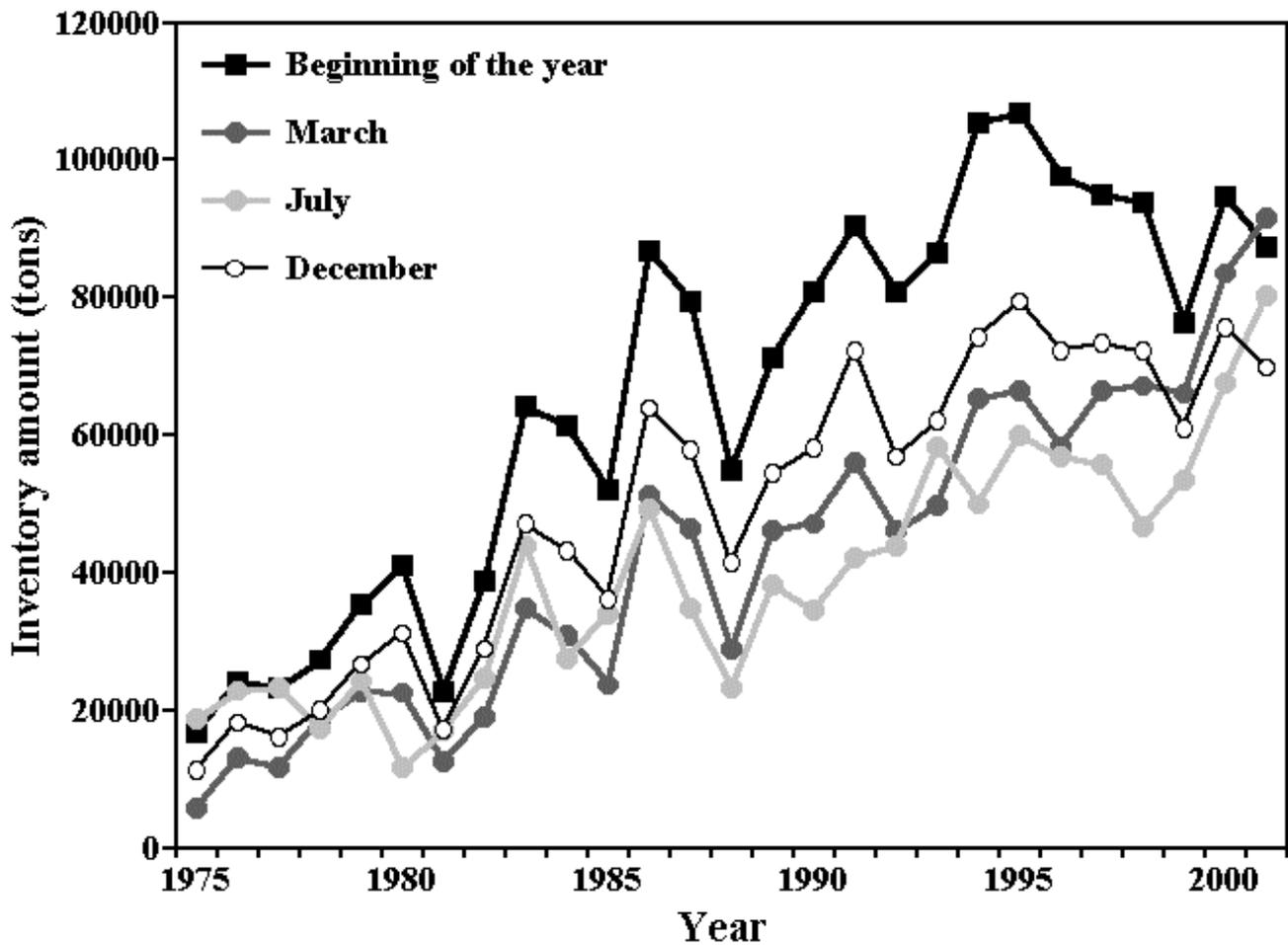
Figure 4. Annual variations in the inventory amounts of fresh-cold salmon in the beginning of the year, the ends of March, July and December from 1975 to 2001.
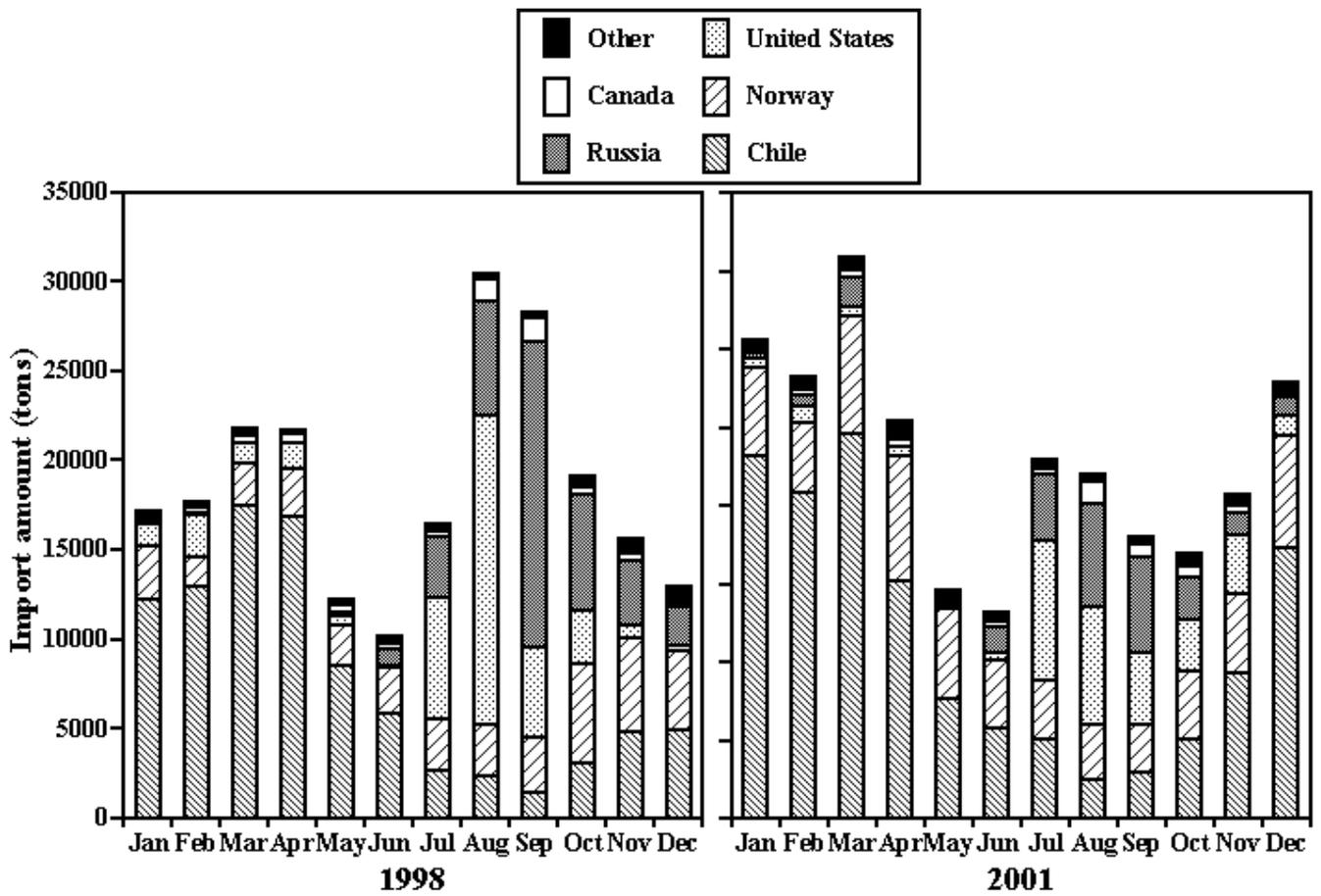
Figure 5. Monthly variations in the import amounts of fresh salmon from main countries in 1998 and 2001.