The Impact of the MSC certification on the Japanese fisheries: Case of the Kyoto Flathead Flounder Danish Seine Fishery

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Abstract

This paper investigates the impact of a Japanese fishery's MSC certification on the related seafood markets. In September 2008, the Marine Stewardship Council (MSC) certified the Kyoto flat-head flounder Danish seine fishery (KDSFF) as the first sustainable fishery in Asia. Assuming the MSC certification has an impact on the fishery, the overall goal is to examine the benefit of the KDSFF from the MSC certification. The benefit is examined by a cointegration and structural break test whether the KDSFF experiences market segregation by the certification. The monthly ex-vessel price is analyzed compared with the prices of the adjacent prefectures: Fukui and Hyogo prefectures. The structural break test showed that the significant impact on the structure of the flathead flounder fisheries while there is no increase in price. In conclusion, the KDSFF benefits from the MSC certification in that the market used to be easily influenced by the other larger markets, but became less influenced by them after the introduction of the MSC certification.

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3.1 Introduction

Seafood ecolabeling has a possibility to improve the fishery resource problem in the world from the consumer side. If consumers preferred the ecolabeled seafood, the preference would generate a price premium for ecolabeled seafood or increase in the market share of ecolabeled seafood. Consequently, profit maximizing fisheries would be motivated to obtain the certification. In order to qualify for the ecolabel, the fishery is required to run a sustainable management because the product must have originated from a sustainable fishery. In this sense, seafood ecolabeling brings a benefit not only to the health of the ecosystem, but also to the certified fisheries (Gudmundsson and Wessells, 2000).

The overall goal of this study is to investigate whether the seafood ecolabeling is functional in the Japanese seafood market. The Japanese seafood market is examined because it is one of the most influential seafood markets to global fisheries; it is the largest seafood importing country and the second largest seafood consuming country in the world; 30% of the world's seafood enters the Japanese market (FAO, 2006). Therefore, the focus of this study is on the Japanese seafood market rather than other markets, considering the nature of ecolabeling.

As an empirical case, this study examines the Kyoto Danish Seine Fishery Federation (KDSFF) in Japan. The KDSFF qualified for the Marine Stewardship Council (MSC) certification, which is the largest sustainable seafood program and has more than 10,000 products in the world (MSC, 2011). The KDSFF is a small fishery compared with large scale adjacent uncertified fisheries—Fukui and Hyogo prefectures—which share the same target species and stock as the KDSFF.

A benefit should be observed in the market if the ecolabeling is functioning in the Japanese seafood market. There are two possible benefits from the MSC certification: price premiums and market segregation between the certified and uncertified products. An analysis of price premium is more intuitive to investigate the benefit from the MSC certification. However, considering the result of the previous manuscripts, the Japanese consumers will not be willing to pay a premium for ecolabeled product without enough educational campaigns at the moment.

This study examines whether the MSC certification changes the structure of the markets and segregates a certified fishery from uncertified fisheries. If consumers regarded ecolabeled seafood as a different product from the conventional seafood, the ecolabeled seafood would be segregated and would create a niche market (Loureiro and Hine, 2002). The organic food demonstrates a good example; the organic food products have been segregated as different products from the conventional ones in the market, while the share of organic food is relatively small (Singerman, et al., 2010). Small scale fisheries have a problem that their prices tend to be sensitive to exogenous shocks from larger markets. One case that shows a solution to the problem is the mackerel fishery in Seki, Japan. The fishery consolidated its high quality mackerels as “Seki mackerels”, and successfully segregated the products from the conventional ones by the branding campaigns (Ishida and Fukushige, 2010). The fishery now sells the products not only local but also all over Japan at a much higher price than the conventional ones. For small fisheries, consolidation of a distinct brand including the MSC brand is one of the benefits in that they face fewer competitors and that they can expect stable revenue.

In order to analyze this objective, a cointegration test and structural break test are employed. The cointegration test follows the Johansen’s procedure to investigate the long-run relationships between the certified and uncertified markets. The structural break is tested by a rank constancy test. The rank constancy test compares the market cointegration in the pre- and post-periods of a known structural break. In order to discover the change in price, predicted price is compared with the real price. Assuming there was no structural break, this analysis can predict the price without structural break, and discover whether the real price with a structural change is higher than the predicted price without the change by comparison after the post-certification period.

The following section explains the characteristics of the KDSFF and the other fisheries, including the ecology and the habitat of flathead flounder. The third section describes the details of the data across the three prefectures. The fourth section explores the structural break of the MSC certification and market relationship. The last section concludes this study.

3.2 Background

3.2.1 History of the Kyoto Danish Seine Fishery

The Kyoto Danish Seine Fishery Federation (KDSFF) was established in 1944, targetingmultiple species including *Chionoecetes opilio* (snow crab), and *Hippoglossoides dubius* (flathead flounder) with prefectural and ministerial licenses. Since both the habitats of snow crabs and flathead flounders are in the same areas, the KDSFF applied both species for the MSC certification. Although the history of the trawl fishery in Kyoto is more than 600 years old, overfishing had not occurred until recently. After suspension of fishing activities due to World War II, the fisheries resumed their fishing activities from almost a virgin resource. At that time, the fishing ground was limited only by licenses, and snow crabs became popular among the Japanese consumers. These situations drove fishermen to over-fish, followed by a rapid decrease in stock due to the overfishing. The flathead flounder was also over-fished because the habitat of the snow crab overlaps that of the flathead flounder. In 1964, the Japanese government regulated the fishing season and the allowed catch size of the snow crab in the Sea of Japan in order to prevent overfishing. This regulation also influenced fishing season for flat-head flounder. The next year, the government reinforced the regulation. However, the reinforced regulation was not rigorous enough to protect the stocks. In 1979, the KDSFF self-regulated fishing areas of flounder fisheries. Since then, the KDSFF has solely set up self-regulations by their own including the marine protected areas (MPA), by-catch rule and others as seen in Table 1. In 1997, after the Japanese government ratified The United Nations Convention on the Law of the Sea (UNCLOS), the government implemented Total Allowable Catch (TAC) and the Total Allowable Effort (TAE) system in 2003 which regulated all flathead flounder fisheries in the Sea of Japan. As a result of all efforts for preservation, the stock index start rising since 2003 as shown in Figure 1. In addition to the efforts, the 2001 year class flathead flounder which is a large herd of flathead flounders become catchable in 2004, which accelerated the stock recovery and the increase in catch shown in Figure 2 (FRISJ, 2010). Although fisheries of Fukui and Hyogo comply with these regulations as well as seasonal closure, these fisheries "do not implement the same level of fishing rules as the KDSFF" (MSC, 2008). In order to publicize the unique management of the KDSFF, it decided to apply the MSC certification and entered the full assessment process in 2006. The MSC certified the KDSFF as the first sustainable fishery of Asia in September 2008 (MSC, 2009).

3.2.2 Flathead Flounder

Flathead flounder (*Hippoglossoides dubius*) inhabits the Sea of Japan, some part of Tohoku pacific coast and Hokkaido. The species is targeted by trawl and gill net fisheries in the areas. Flathead flounder moves vertically from 150 to 900 meters, depending upon the growth levels and seasons. The spawning ground of the species is located off the shore of Cape Kyogamisaki in Wakasa Bay where Kyoto prefecture has an exclusive right to use the resources. From February to April, flathead flounder moves to the depth of 180 to 200m below the sea surface to lay the eggs and stays at the same depth a while after the spawning season, so fishing activity during this season damages the stock. After mid-June, flathead flounder moves to the depth between 200 and 300 m in the Wakasa Bay area. Flathead flounder preys on Ophiuroideas through a year and the predators of flathead flounder are Sepparikajika (*Malacocotus gibber Sakamoto*) and Tanakagenge (*Lycodes tanakai*). Due to overfishing, Fisheries Agency of Japan included flathead flounder as one of the species of the first class Marine Resource Recovery Plan (FRISJ, 2010).

3.2.3 Fishing Ground and Characteristics of Fisheries

Figure 3 shows the geographic locations of Danish seine fisheries in Kyoto, Fukui and Hyogo within their boundaries of the Exclusive Economic Zone (EEZ) of Japan. The fishing ground off the shore of Hyogo, Kyoto and Fukui is utilized as a common fishing ground by the offshore fisheries which are licensed by the Minister. The other fisheries, licensed by a governor, operate the fisheries relatively closer to the coast. Table 2 shows the number of the ministerial and governor's licensed fisheries and the tonnages of the vessels. All the vessels in Kyoto belong to the KDSFF, and most of them operate their fisheries within one day trip or two. On the other hand, Hyogo mainly operates their fisheries offshore and their vessels are larger than those of Kyoto and Fukui. Fukui fisheries mostly operate near the coast while some of them go offshore to fish. Flathead flounder migrates horizontally from eastern Fukui area to western Hyogo area. It follows that the fisheries in this area share the same products (FRISJ, 2010).

3.3 Data

3.3.1 Details of Market Data

In order to compare the certified and uncertified fisheries, their products should compete within the same market. From this view point, the price of one particular market in Kyoto, Maizuru market, is adopted as a representative of the Kyoto market in the following reasons.

Firstly, Maizuru is the only market which competes with the product from the other prefectures. Kyoto has four landing ports including Maizuru, Taiza, Amino and Miyazu. The products from all the markets except Maizuru are mainly for local consumption while 80% of products from Maizuru go to central markets in Kyoto and Osaka according to the KDSFF (Ariji, 2006). Fukui has five landing ports and the products from the three ports go to the markets including Osaka and Tokyo central wholesale markets. The landings of the other two ports go to the central wholesale market in Fukui (Fukui, 2010). Hyogo has five landing ports for flathead flounder and products tend to go to the central markets including Kyoto, Osaka and Tokyo (Hyogo, 2006). Thus the products of Maizuru, Fukui and Hyogo are comparable because they compete with each other in the central markets in Osaka or Kyoto.

Secondly, fishermen in Maizuru spend equal days at sea per trip to those in Hyogo and Fukui prefectures. Fishermen in Maizuru take two to three days for one trip while the other three local ports in Kyoto usually take one day. Fishermen in Hyogo and Fukui take more than two days per trip. It follows that the product quality from these markets should be similar.

Thirdly, 150kg of the landing in Maizuru is sold as MSC certified flathead flounder (Yamasaki, 2011). Although Maizuru is the best to compare with the other market data, since the conventional market prices are not weighted averages, the analysis of arithmetic average has to be taken into account because the result may magnify the influence of the MSC certification.

Table 3 shows the summary statistics of the flathead flounder fisheries in the three prefectures. The monthly ex-vessel prices of flathead flounder in Kyoto, Fukui and Hyogo prefectures are shown in Figure 4.[1] Ex-vessel prices are obtained from landing sales divided by landing quantities. The price in the Maizuru market is constantly lower than those in the other two markets. One reason is that the products from the Maizuru market are relatively less fresh than the other markets in Kyoto, which lowers the price of Maizuru (Ariji, 2006). However, the quality of the product in Maizuru is no different from that in Fukui and Hyogo considering the days at sea among the fisheries.

3.3.2 Stationarity

Since most of the time series data are in a nonstationary process, stationarity is tested by the Augmented Dickey-Fuller (ADF) unit root test because nonstationary data series create a bias (Enders, 2004). Lags are added based on the minimum values of AIC, SBIC and QHIC so that error terms follow white noise. The regression used for the ADF test is expressed as follows (Enders, 2004).

$$\Delta \mathrm{p}_{\mathrm{jt}} = \beta_0 + \beta Tr + \sigma p_{j,t-1} + \sum_{k=1}^{K} \alpha_k \Delta p_{i,t-k} + \varepsilon_t \qquad (1)$$

where $\Delta \mathrm{p}_{\mathrm{it}}$ is the first difference of a price for the market *j*, at time *t*. Tr is a trend, β_0 is a constant term. σ is tested to be zero whether or not p_{it} follows a unit root process. The rejection means that the system is in a stationary process. Table 4 shows the results of ADF tests. In the ex-vessel prices, not all the prices rejected the null hypothesis of non-stationarity, but all the prices of their first differences did reject the null hypothesis. These results were consistent when trend and drift terms were included. So these price systems are integrated of order one.

3.3.3 Seasonal Closure

Flathead flounder fisheries in the prefectures start fishing season at the beginning of September and end at the end of May. Although there is no missing value during the fishing seasons, the data system contains a three-month gap for all prefectures annually. Schafer and Olsen (1998) mentioned a risk of ignoring missing data, which results in artificially low standard errors and p-values. In the literature of time series analysis, there is no data containing seasonal closure except the previous study of snow crab fisheries in the KDSFF (Ariji, 2006), but some literature exists in winter tourism studies (Falk, 2010). A practical method to treat unimputable missing data is to convert the data from the original frequency to lower frequency (e.g. daily to weekly, monthly to quarterly). However, we use the original data following the previous study about the KDSFF's snow crab fishery (Ariji 2006) because the data is continuous. No fishing vessels are allowed to enter the fishing ground, and no flathead flounder fisheries in the area of the Sea of Japan operates during

[1] Although local market data are available in Kyoto as the certified market, only aggregated data of markets are available for Fukui and Hyogo prefectures.

the seasonal closure.[2] This can be regarded as a weekend and holiday gap in the stock and exchange markets, in which many journal articles are published dealing the daily data with 5 or 6 business days with weekend gaps and the data in this study can be regarded as the same kind of data as those in exchange and stock markets (Copeland, 1991; Engle and Ng, 1993; Hamilton, 1996). When the data have weekend and holiday gaps, these gaps are ignored after checking disparity of the gap, such as the day-of-week effect and the pre- and post- holiday effect.[3] In our data, there exists no big disparity before and after the gaps. This is because the best season for flounder consumption is winter and not much demand exists in the summer. However, in order to factor out the seasonal component, seasonal dummy is introduced into the model.

3.4 Does the MSC Certification Trigger A Structural Change?

Structural break tests are conducted in order to verify that the KDSFF's MSC qualification had an impact on its own fishery and adjacent uncertified fisheries. The multiple structural breaks are tested based on the test developed by Bai and Perron (1998). The model is a simple first autoregressive model,

$$p_t^i = a^i + b_{t-1}^i p_{t-1}^i + e_t^i \qquad (2).$$

p_t^i is a price of fishery *i* at *t*-th period. *a* is a constant term and *e* is an error term of N(0, σ^2). The null hypothesis is tested that no structural change occurred in the series whereH_0: $b_{t-1} = b_0$ against the alternative hypothesis that b_{t-1}varies over time. The test is conducted in R using a package for structural change test, *strucchange*, coded by Zeileis et al (2003).

3.4.1 Cointegration Test

Market relationship will be revealed by conducting cointegration test. There are two approaches for a cointegration test: the Engle and Granger (1987) test and the Johansen test (1990). Since the Johansen test enables researchers to test cointegration with a multivariate format, this study adopts the Johansen test. The bivariate model for the cointegration test with lagged variables is constructed in order to account for short-run and long-run relationships between the commodities (Slade, 1986). The model is modified of equation (2) expressed by,

$$p_t^i = a + \sum_{i=1}^{I} \sum_{k=1}^{K} b_k^i p_{t-k}^i + \sum_{n=1}^{N} \phi d_n^i + e_t^{\mathrm{i}} \, . \qquad (4)$$

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[2] Although Fukui and Hyogo have some sales during the seasonal closure, the landings are mainly by-catch from different fisheries and ignorable according to the KDSFF.

[3] One way to treat seasonality is seasonal adjustment. X-12 ARIMA method by Fidley et al. (1998) which is the most common seasonal adjustment method developed by the US Bureaus of the Census and used by many governmental statistic departments. However, X-12 ARIMA does not smooth our data because our data do not show such obvious seasonality from the data plot, and irregular components make seasonal adjustment not effective.

k denotes the number of lags. d is a seasonal dummy for month n. The bivariate model can be extended to the multivariate in the following (Enders, 2004, Johansen and Juselius, 1990),

$$P_t = \mu + \sum_{l=1}^{K} A_k P_{t-k} + \Phi D + \mathrm{E}_t \ , \tag{5}$$

where P_{t-k} is an i x 1 price vector at the time period t-k, i is the number of the markets, μ is a constant, each of $A_1 \ldots . A_k$ is a i x i matrix of parameters, k is lag length, Q_{t-r} is a r x 1 l vector at the time period t-r, B_r is a r x r matrix of parameters for B, D is a n x 1vector of seasonal dummies, and E_t is an i x 1 vector of error terms which is stationary and iid distributed $N(0,\sigma^2)$. We first examine the bivariate relationships, and then expand to multivariate relationships to support the bivariate results (Asche, et al., 2005). In order to take into account the influence of the amount of landings on prices, dynamic landing data are included in the model (Nijs, et al., 2001, Sathianandan, 2006). In order for equation (5) to be the first difference stationary due to nonstationarity of the data, the error correction form of the equation above is described in the following (Enders, 2004). Lagrange-multiplier test is conducted for autocorrelation in the residuals.

$$\Delta P_t = \sum_{i=1}^{k-1} \pi_i \Delta P_{t-i} + \pi P_{t-k} + \sum_{r=0}^{r} B_r Q_{t-r} + S + \mathrm{E}_t \tag{6}$$

$\pi_i = \ -I + \ A_1 + \cdots + \ A_i$, where $A_i = -I + \ A_1 + \cdots + A_k$. $\mathrm{Q_{t-r}}$ is a vector of landings at t-th period with r lags. All the variables in the right-hand side except πP_{t-k} are stationary, and πP_{t-k} is a linear combination with integration of order one. However, since the assumption forces an error term to be stationary, πP_{t-k} must also be stationary. It follows that either π must be zero, or P_{t-k} must have a number of cointegration vectors. If P_{t-k} has cointegration vectors, the rank, r, shows how many linear combinations are stationary. A cointegration test is conducted to determine how many linear combinations reside in the equation. If $r = 0$, (i.e. π is zero) no linear combination is stationary; if $0 < r <$ n, r linear combinations are stationary; if $r = n$, every variable is stationary. The rank is identified by the maximum eigenvalue and trace test by testing likelihood ratios between the ranks (Enders, 2004).

Preliminary conjecture is that the relationship between prefectures is cointegrated before the KDSFF's MSC certification, but the relationship stops being cointegrated after that. It follows that the MSC certification changes the related markets from homogeneous markets to heterogeneous markets.

3.4.4 Empirical Results

A structural break test found multiple structural shifts in Maizuru: February 2002, December 2004 and December 2008. One structural shift occurred in Fukui (October 2006) and in Hyogo (February 2004), while the test results of Fukui and Hyogo indicate no structural shift in 2008. Considering the timing of the structural break for MSC certification, there are several different time points for the break. One is September, 2008 because the

KDSFF was certified in September 19th, 2008. Another is October, 2008 because a domestic retailer started selling the ecolabeled flounder on October 1st at 5 stores in Kyoto and Shiga prefectures; the MSC held a ceremony for the KDSFF's MSC award on October 9th; some media picked up the MSC certification around mid-October. The others is November through next February considering a time lag. The test result indicated the break happened on December 2008 during time of the period. Therefore, the structural break occurred with a couple of month delay. The other structural shift occurred in Kyoto and Hyogo 2004 seem to be caused by the inflow of 2001 year class herd of flounders into market as Stock Index pointed out in Figure 1.

The Johansen procedure is employed for non-stationarity data. The results of bivariate and multivariate cointegration tests are shown in Table 5. In the table, Panel A shows the pre-MSC period and Panel B shows the overall period. In the pre-MSC period, no long-run relationship is present in the first two combinations in this period as shown, but the rank is full between Fukui and Hyogo and one long-run relationship exists in the multivariate model. According to the results, three markets were cointegrated before the KDSFF qualified for MSC certification while the market integration does not occur simultaneously (Shahi, et al., 2006). However, the long-run relationship disappears when the post-MSC certified period is included as shown in Panel B.

3.6 Conclusion

The purpose of this study is to examine whether the impact of the MSC certification triggers a structural shift in the related fisheries. The structural break test shows a significant impact of the MSC certification on the flathead flounder fisheries. According to the results, the Maizuru market used to be easily influenced by the other two larger markets, but became less influenced by them after the introduction of the MSC certification. The building of new costumers is one possible reason. One of the biggest retailers in Japan has contacted the KDSFF right after their MSC certification to deal the ecolabeled products, several retailers have currently been interested in the KDSFF's sustainable flathead flounder (Yamasaki, 2011). The difference in fishery management policies is another possible reason. As shown in Table 1, the KDSFF has been practicing unique self-regulations. In addition to all the self-regulations in the table, the KDSFF has solely prohibited fishing in particular areas to protect the male soft-shelled snow crabs in September and October since 1990s. In April and May, the KDSFF has limited its fishing activities only during daytime in order to avoid by-catching snow crabs. These self-regulations distinguish them from other fisheries, and might cause the structural shift.

Although the structural change has not caused a price premium, the market segregation appears as a sign of a benefit from the MSC certification. Now that the consumers regard the product of the KDSFF differently, the KDSFF can expect a new marketing strategy without taking into account the trend of the major markets. As a sustainable fishery, the KDSFF can promote itself as a stable supplier. The present issue in fisheries is the difficulty of stable supply due to frequent stock depletion. Many buyers have made efforts to seek substitution products for the constant supply. A sustainable fishery is of interest to many retailers as a stable supplier of products, which also brings long-term revenue to the fishery. This is one possible survival strategy for small scale fisheries..

The result of this study concludes that the MSC certification by the KDSFF has significant impacts on the certified market and the conventional markets. This proves that seafood ecolabeling is functioning at the ex-vessel price level in Japan as it is intended to: to benefit the sustainable fishery management. Although the success in future depends on how many Japanese seafood consumers become aware of the seafood ecolabeling, the stakeholders of the seafood ecolabeling have an enough possibility to invest on the Japanese market.

References

Ariji, M. 2006. *Quantitative Analysis of Fishery Economics: Theory and Practice (Japanese)*. Tokyo: Seizan Shoten Co.

Asche, F., A.G. Guttormsen, T. Sebulonsen, and E.H. Sissener. 2005. "Competition between farmed and wild salmon: the Japanese salmon market." *Agricultural Economics* 33:333-340.

Bai, J., and P. Perron. 1998. "Estimating and Testing Linear Models with Multiple Structural Changes." *Econometrica* 66:47-78.

Copeland, L.S. 1991. "COINTEGRATION TESTS WITH DAILY EXCHANGE-RATE DATA." *Oxford Bulletin of Economics and Statistics* 53:185-198.

Enders, W. 2004. *Applied Econometric Time Series*. 2nd ed: John Wiley & Sons, Inc.

Engle, R.F., and C.W.J. Granger. 1987. "COINTEGRATION AND ERROR CORRECTION - REPRESENTATION, ESTIMATION, AND TESTING." *Econometrica* 55:251-276.

Engle, R.F., and V.K. Ng. 1993. "MEASURING AND TESTING THE IMPACT OF NEWS ON VOLATILITY." *Journal of Finance* 48:1749-1778.

Falk, M. 2010. "A dynamic panel data analysis of snow depth and winter tourism." *Tourism Management* 31:912-924.

FAO (2006) "Fishery Commodities Global Production and Trade (online query)." In., FAO.

FRISJ. 2010. *Stock Recovery Plan for Flathead Flounder (and Snow Crab) in the Western Area of Sea of Japan.* Fishery Angency.

Fukui. 2010. *Fish in Fukui: Enegetic Sales Strategy (Japanese).*

Gudmundsson, E., and C.R. Wessells. 2000. "Ecolabeling Seafood for Sustainable Production: Implications for Fisheries Management." *Marine Resource Economics* 15:97-113.

Hamilton, J.D. 1996. "The daily market for federal funds." *Journal of Political Economy* 104:26-56.

Hyogo. 2006. *Hyogo Prefecture Wholesale Market Arrangement Plan (Japanese).*

Ishida, T., and M. Fukushige. 2010. "The effects of fishery harbor-based brands on the brand equity of shore fish: An empirical study of branded mackerel in Japan." *Food Policy* 35:488-495.

Johansen, S., and K. Juselius. 1990. "MAXIMUM-LIKELIHOOD-ESTIMATION AND INFERENCE ON COINTEGRATION - WITH APPLICATIONS TO THE DEMAND FOR MONEY." *Oxford Bulletin of Economics and Statistics* 52:169-210.
Loureiro, M.L., and S. Hine. 2002. "Discovering Niche Markets: A Comparison of Consumer Willingness to Pay for Local (Colorado Grown), Organic, and GMO-Free Products." *Journal of Agricultural and Applied Economics* 34:477-477-487.
MSC (2011) "More choice for seafood consumers as MSC-labelled products reach 10,000 mark." In. http://www.msc.org/.
Nijs, V.R., M.G. Dekimpe, J. Steenkamp, and D.M. Hanssens. 2001. "The category-demand effects of price promotions." *Marketing Science* 20:1-22.
Sathianandan, T. 2006. "Modeling marine fish landings and environment using VARX models." *Journal of the Marine Biological Association of India* 48:46-50.
Schafer, J.L., and M.K. Olsen. 1998. "Multiple imputation for multivariate missing-data problems: A data analyst's perspective." *Multivariate Behavioral Research* 33:545-571.
Shahi, C., S. Kant, and F. Yang. 2006. "The Law of One Price in the North American softwood lumber markets." *Forest Science* 52:353-366.
Singerman, A., S.H. Lence, and K.E. Amanda. 2010. Title."Unpublished, Institution|.
Slade, M.E. 1986. "EXOGENEITY TESTS OF MARKET BOUNDARIES APPLIED TO PETROLEUM-PRODUCTS." *Journal of Industrial Economics* 34:291-303.
Yamasaki, A. Kyoto Forestry and Fisheries Technology Center.
Zeileis, A., C. Kleiber, W. Krämer, and K. Hornik. 2003. "Testing and dating of structural changes in practice." *Computational Statistics & Data Analysis* 44:109-123.

Tables

Table 1. Regulations of Flathead Flounder in Kyoto Offshore Areas

Year	Regulations	Kyoto	Fukui	Hyogo
1965	Seasonal Closure	○	○	○
1979	Further Seasonal Closure	○	×	×
1984	Marine Protected Areas	○	×	×
1994	By-catch rule	○	×	×
1997	Total Allowable Catch	○	○	○
1999	Size regulation	○	×	×
2003	Total Allowable Effort	○	○	○
2005	Introduction of improved nets	○	×	×

Table 2. Number of Licensed Fisheries and their Vessel Tonnages

	Ministerial License		Governor license	
Prefectures	vessels	tons	vessels	Tons

Fukui	27	47.2	69	11.9
Kyoto	2	18.5	15	14.5
Hyogo	61	64.7	2	14.8
Total /Ave	90	58.4	86	12.4

Source: Fishery Research Institute 2010

Table 3. Summary Statistics of Three Prefecture

Periods	Certified Fishery			Uncertified Fisheries					
	Kyoto (Maizuru)			Fukui			Hyogo		
	Mean Landing (kg)	Mean Sales (1000 yen)	Ex-vessel Price (yen/kg)	Mean Landing (kg)	Mean Sales (1000 yen)	Ex-vessel Price (yen/kg)	Mean Landing (kg)	Mean Sales (1000 yen)	Ex-vessel Price (yen/kg)
Before MSC Certification (Jan00/Sep08)	7,064	3,036	525	83,051	62,015	840	88,719	68,742	868
After MSC Certification (Oct08/Dec10)	11,811	4,090	408	161,430	77,972	532	128,126	77,598	632
Overall (Jan00/Dec10)	8,071	3,259	500	99,677	65,400	775	97,078	70,621	818

Table 4. Results of the ADF Tests at the Prices of Level and First Difference

ADF	Trend	Drift	Trend(D1)	Drift(D1)
Maizuru	-2.79	-1.58	-4.58***	-4.61***
Fukui	-2.80	0.19	-4.80***	-4.47***
Hyogo	-1.78	-0.63	-3.60**	-3.62***

Note 1: Values in the table show t values of ADF test statistics, and D1 indicates the first difference level.

Note 2: Mackinnon Approximate P values are shown as two and three stars standing for 5% and 1% levels of statistical significance respectively.

Table 5. Johansen Trace and Max Cointegration Test

	Rank=0		Rank = 1		Rank=2		
Prices	Max	Trace	Max	Trace	Max	Trace	Rank
Maizuru/Fukui	9.93	0.00	0.14	0.00			0
Maizuru/Hyogo	7.54	7.86	0.32	0.32			0
Fukui/Hyogo	14.25*	19.15*	4.90*	4.90*			Full
3 prefectures	21.14*	36.30*	9.98	15.16	5.18	5.18	1

A star ,*, indicates 5% significance levels

Panal A: January 2000 through December 2008

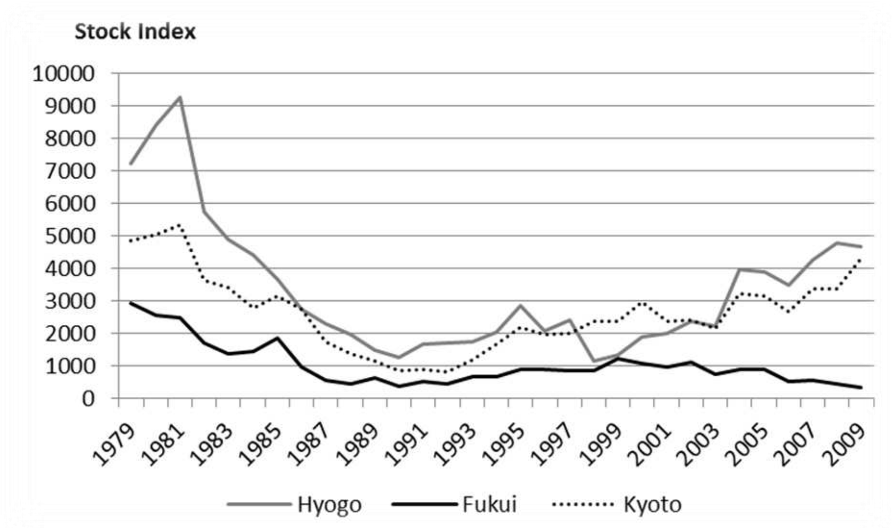
	Rank=0		Rank = 1		Rank=2		
Prices	Max	Trace	Max	Trace	Max	Trace	Rank
Maizuru/Fukui	11.65	11.79	0.14	0.14			0
Maizuru/Hyogo	13.53	14.61	1.08	1.08			0
Fukui/Hyogo	10.32	11.03	0.71	0.71			0
3 prefectures	19.68	28.66	8.35	8.98	0.62	0.62	0

Panel B: January 2000 through December 2010

Table 6. Structural Break Tests

	Rank Constancy test	
	χ^2	p-value
Maizuru-Fukui	11.38	0.00
Maizuru-Hyogo	8.33	0.02
Maizuru-Fukui-Hyogo	13.14	0.00

Figures



Source: Fishery Research Institute of Sea of Japan, 2010

Figure 1 ABC Stock Index across Three Prefectures (Kyoto, Fukui and Hyogo)

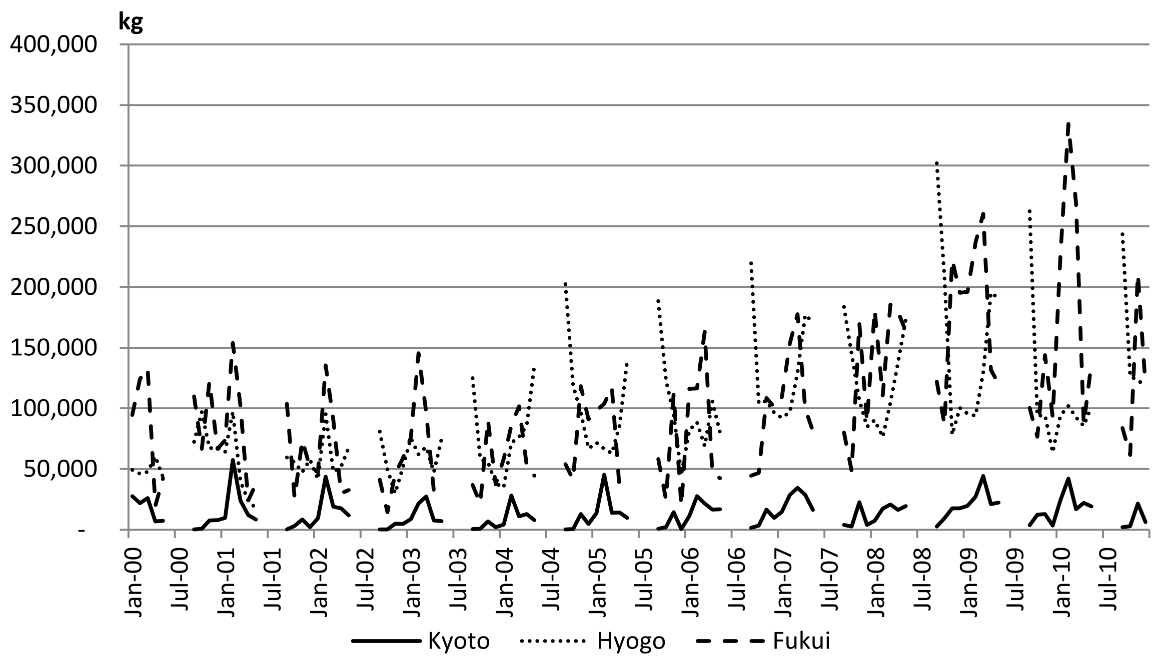
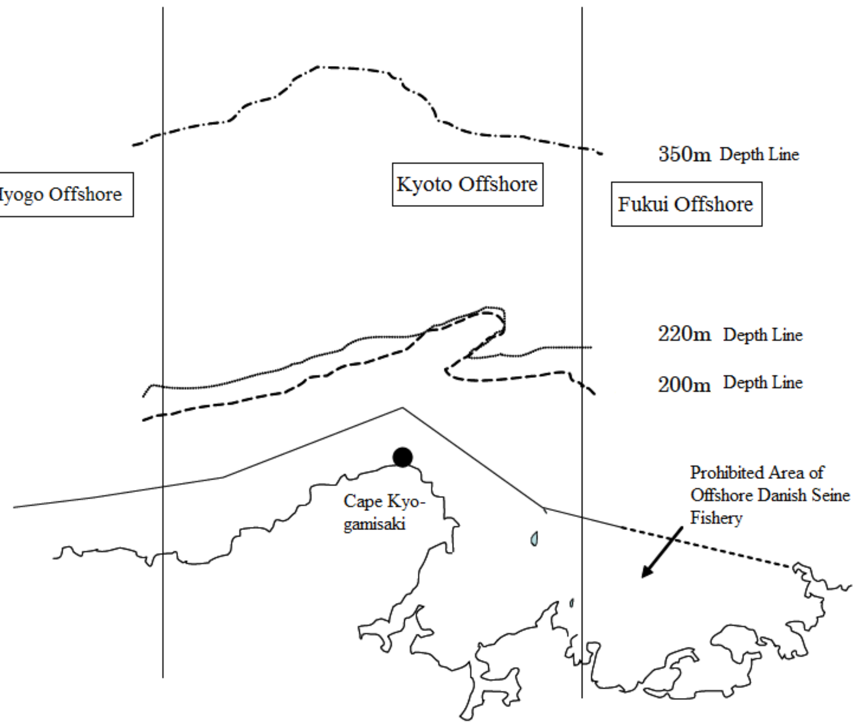


Figure 3 Monthly Landings of Kyoto, Fukui and Kyoto



Source: MSC Final Public Report 2008

Figure 2. Wakasa Bay: Kyoto, Fukui and Hyogo Offshore Fishing Areas

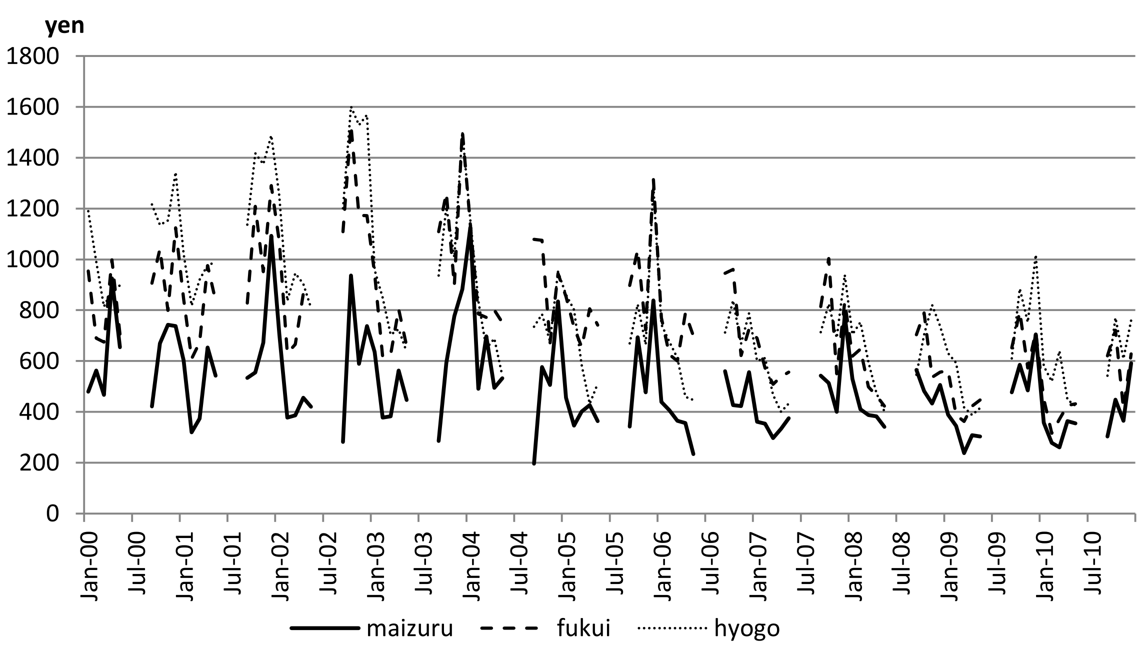


Figure 4. Ex-Vessel Prices across Three Prefectures