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12 April 2016

Online at https://mpra.ub.uni-muenchen.de/70661/
MPRA Paper No. 70661, posted 14 Apr 2016 07:03 UTC

Market Integration Analysis of Japan's Wakame Seaweed Market Before and After the Great East Japan Earthquake

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Abstract:

The 2011 Japanese earthquake had a major impact on markets for seafood products. As such, this study investigates its effect on the price of a brand of wakame seaweed produced in Sanriku, an area hit hard by tsunamis. Using monthly data on Sanriku wakame prices at retail stores in 10 regions of Japan from 2005 to 2014, we undertake cointegration analysis to explore the effect of reputational damage due to radioactive contamination and changes in domestic market dynamics. Market integration analysis reveals that the market changed after the earthquake. Before the earthquake, markets in eastern Japan were leading those in the west. However, after the earthquake, markets in the east were integrated and mutually influenced one another. The earthquake also resulted in diversified distribution channels and complicated regional relationships because buyers constructed their own channels for purchasing wakame during the earthquake.

Keywords: Japan, seaweed, market integration, granger casualty test, cointegration test

JEL Code: Q22, D4

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Introduction[1]

The Great East Japan Earthquake and associated tsunamis of 2011 caused critical damage to the east coast of Japan. In particular, massive tsunamis in the Sanriku region damaged aquaculture of wakame seaweed (*Undaria pinnatifida*), a key source of livelihoods for local fishermen. This region also played an important role in the overall domestic market, as it was responsible for 70% of domestic production (Miyata et al. 2008). The tsunamis not only destroyed almost all wakame production facilities but also indirectly threatened the security of the seafood population through the flow of contaminated water from the Fukushima Daiichi nuclear power plant into the ocean. The Great Earthquake thus resulted in critical damage to Sanriku's wakame producers. Even years later, reputational damage due to the Fukushima disaster and repeated leaks of contaminated water into the Pacific Ocean have undermined the Sanriku brand.[2]

To revitalize the failing brand, the Sanriku wakame industry needs to understand how the earthquake impacted the domestic market situation, and how the dynamics between near and distant markets changed as a result. The existing literature on brand consolidation shows that

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[1] Abbreviations used in this paper include point of sales (POS) and law of one price (LOP).

[2] Fisheries in Fukushima were also ruined, but they have not yet resumed their fishing operations due to regulations related to radioactive contamination. This article thus focuses on the Sanriku region, in which fishermen have already resumed operations but suffered difficulties in recovering from the earthquake.

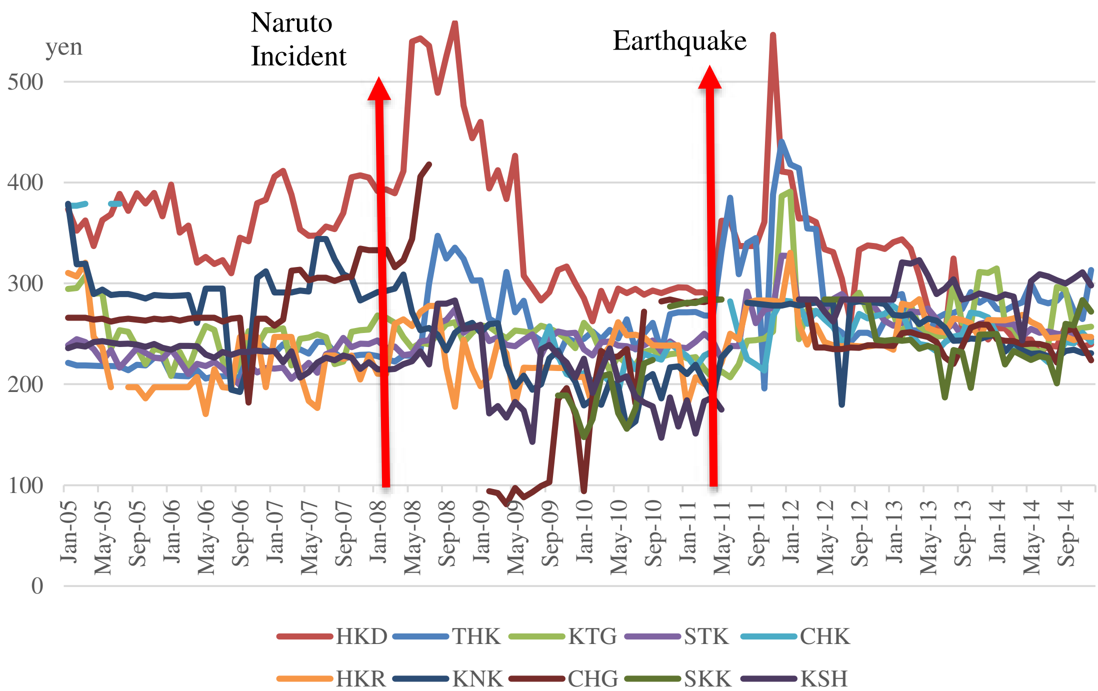
the Sanriku wakame brand has achieved strong brand equity among wakame seaweed producers in Japan (Miyata et al. 2008). The price premium compared to foreign wakame products could be higher than 30%, even after the earthquake (Wakamatsu and Miyata 2015). The effects of radioactive contamination, however, have cast a dark shadow over Sanriku's wakame producers. These producers claim that buyers in western Japan, especially in the Kinki region, stopped dealing with Sanriku producers due to potential contamination and that the producers are unable to sell wakame at prices higher than those before the earthquake (Yamazaki 2013). In order to scientifically confirm these fishermen's contentions, this study investigates whether a bad reputation arising from the earthquake has harmed distribution chains of the Sanriku wakame. This study will thus investigate domestic market dynamics across 10 regions using intervention and cointegration analyses based on market data.

2. Methods

This study uses retail scanner data, so called point of sales (POS) data, to analyze retailers' wakame sales across 10 regions of Japan. The data was obtained from Nikkei Media Marketing, Inc. A POS system was launched in 1985 in Japan; ever since, various types of sales data have been available at the retailer level. These include monthly figures for more than 300 types of wakame products, comprising prices, quantity, brands, places of origin, and product types (e.g., salted wakame, dried wakame, or wakame stem).

This data, covering the entire Japanese domestic market, comes from retailers in 10 regions of Japan: Hokkaido (HKD), Tohoku (THK), Kanto-Rim (KTG), Tokyo and sub-urban Tokyo (STK), Chukyo (CHK), Hokuriku (HKR), Kinki (KNK), Chugoku (CHG), Shikoku (SKK), and Kyusyu (KSH). Since all products sold in a given region are listed, the number of wakame products ranges from 46 to 86. Product origins include both domestic and imported brands. Domestic brands include Sanriku, Naruto—the second-largest wakame brand after Sanriku—and others. Imported brands, such as Chinese and Korean products, account for more than 60% of the total supply. This study focuses on the Sanriku brand in order to investigate a wakame brand from an area devastated by the earthquake. The monthly data cover from January 2005 to December 2014, but some missing data exists in more distant areas, which do not sell the Sanriku brand.

Figure 1 displays prices for Sanriku salted wakame (in 100 g) at retail stores across 10 regions. There are two key milestones in this chronological graph: the Great East Japan Earthquake and a mislabeling scam involving the Naruto brand (*the Naruto Incident*). The earthquake led to a moratorium on Sanriku wakame supply since it hit in March, right before the harvest, and swept away all facilities for wakame production in the region.[3] The devastation prevented the distribution of wakame from the western Sanriku region. Figure 2 shows the average supply of wakame products (in kg) at retail stores. Most of the stores located in western Tohoku region stopped supplying Sanriku wakame after the earthquake.



[3] Wakame production is seasonal, with the harvest mainly occurring between mid-March and the end of April.

Figure 1. Demonstrates average store prices of Sanriku salted wakame (100 g) across 10 Regions

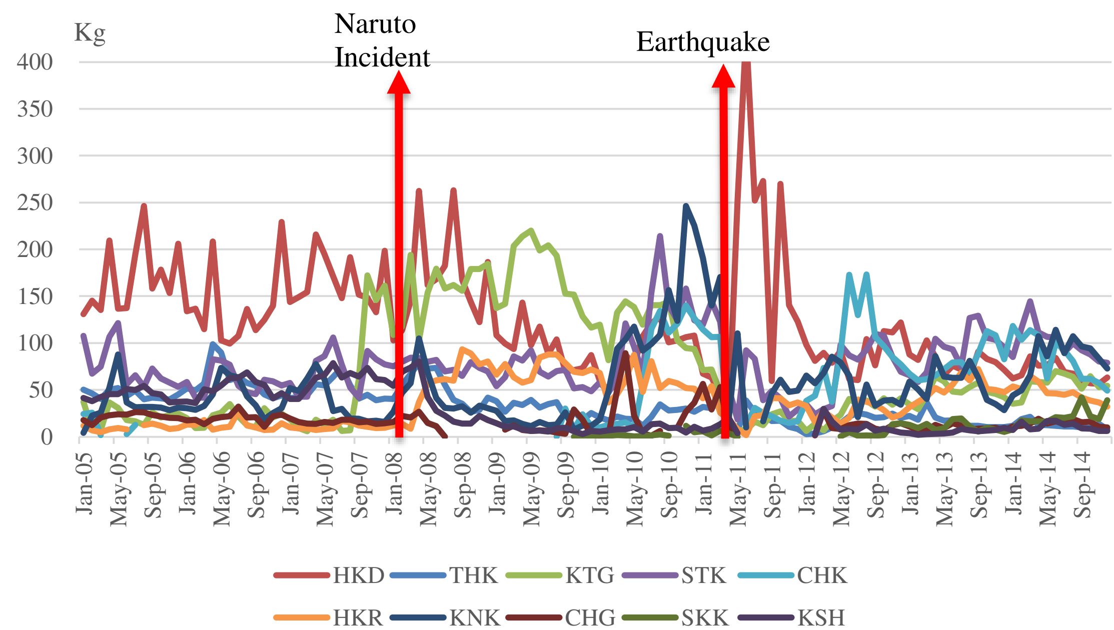


Figure 2. demonstrates average Sanriku wakame supply in stores across 10 regions

The mislabeling scam occurred in January 2008 in Kinki region.[4] This incident brought chaos to the domestic wakame market for at least a year (see Figure 1). Since the Naruto Incident might have had an unexpected influence on the domestic market, we generally avoid including this period in the analysis. However, some parts of the analysis do use this period due to a lack of data; interpretation of these results must thus consider the Naruto Incident's potential influence.

[4] Multiple processors, including the largest processors in Naruto city, mixed Korean wakame into the Naruto brand. Once this was brought to light, they stopped mixing and invested in a major promotion to recover their brand's value; this successfully prevented sales from decreasing in the vicinity of the Kinki region.

3. Theory

We use market integration analysis to understand changes in market relationships between before and after the earthquake: the results reveal how domestic markets were previously and how they changed after the earthquake. Cointegration and Granger causality tests can be used to examine linkages between the markets and their relationships, such as whether one is a price leader or a follower.

A wide-ranging body of literature on market integration exists (Asche et al. 2012; Asche et al. 1999; Asche et al. 2004; Asche et al. 2005; Bachmeier and Griffin 2006; Bose and McIlgorm 1996; Nielsen 2005; Norman-López et al. 2013; Wakamatsu 2014). In economics, the law of one price (LOP) holds under perfect competition, and their market prices converge to one price as market linkages are created between markets. The markets may remain nonintegrated if they are independent of each other or if the goods are of different types, such as higher and lower qualities. In addition to testing for whether the LOP holds, market integration analysis can offer profound insights into market relationships. The Norwegian aquaculture industry, for example, is a major global exporter of salmon, but the relationship between wild and farmed salmon was once unknown. Asche et al. (2005) found that these products are substitutes for one another; this insight informed the Norwegian salmon aquaculture industry's marketing strategies. Knowledge of market integration in Japan's domestic wakame markets can also offer important information to help Sanriku wakame producers promote their products. In order to analyze the relationship between domestic wakame markets, the Johansen method (1990) tests for cointegration among multiple markets and enables researchers to test cointegration with a multivariate format. The following equation is the multivariate form of the Johansen method (Enders 2004):

$$P_t = A_0 + A_1 P_{t-1} + A_2 P_{t-2} + \cdots + A_k P_{t-k} + e_t \ , \quad (1)$$

where P_t is an n by 1 price vector at time period t, which includes n markets, A_0 is a constant, each of $A_1 \ldots . A_k$ is an n by n matrix, k is the lag length, and e_t is an n by 1 vector of error terms, which is stationary and independently, identically distributed N(0,σ^2). In order to manage the nonstationarity problem in the data, the error correction form for the equation above is described via the following relationship (Enders 2004). Let $\pi_i = -I + A_1 + \cdots + A_i$,

$$\Delta P_t = \sum_{i=1}^{k-1} \pi_i \Delta P_{t-i} + \pi P_{t-k} + \varepsilon_t, \quad (2)$$

where i =1, … , k – 1. Every variable on the right-hand side except for πP_{t-k} is in a stationary process, and πP_{t-k} is a linear combination, integrated of order one. However, πP_{t-k} must be stationary in order for the error term to remain stationary, which indicates that either π must be zero or P_{t-k} must have one or more cointegration vectors. The number of cointegration vectors in

P_{t-k} (the rank, r) shows the number of linear combinations that are stationary. A cointegration test reveals the number of linear combinations in the equation. If $r = 0$, no linear combination is stationary; if $0 < r < k$, r linear combinations are stationary; if $r = k$, every variable is stationary. The rank is identified based on the maximum eigenvalue (max test) and the trace test, testing the likelihood ratios between the ranks (Enders 2004).

4. Results

The max and trace tests were conducted to compare between the pre- and post-earthquake periods. The results showed some differences in the tests statistics between the max and trace tests.[5] Lüutkepohl et al. (2001) found that the trace test is superior to the max test for small samples. Since the sample used in this study is relatively small, we used the results of the trace test. The trace test for multivariate cointegration indicated ranks of two in the pre-earthquake period and three in the post-earthquake period. Thus, the market is imperfectly integrated: some segments within the integrated markets are independent of others or some of the independent markets are integrated. Under the perfectly competitive market, markets are integrated, and the model has nine co-integrating vectors of long-run relationships. To determine the details of the

[5] Unit root tests (Augmented Dicky-Fuller and Phillips-Perron tests) resulted that almost all of the variables are in nonstationary process and integrated of order one (Appendix A).

relationships, bivariate tests were conducted, and found five or six markets are integrated together in both the pre- and post-earthquake periods. Though since the number of combinations reached 36 in each period, we will not present the statistical details, but available upon requests.[6] The bivariate combinations of markets are synchronized when the rank is one and there is a long-run relationship in the markets. For the remainder of the combinations, for which the rank was either full or zero, the market is not linked; we thus conducted Granger casualty tests to determine whether a given market has a one-way causal influence on the other market. (These statistics are also not presented, given that there were 90 combinations, but are available upon request.)

Figure 3 illustrates the market relationship, based on the cointegration tests and Granger causality tests. The round graphics (with abbreviations for the regions) correspond to both the maps and the arrows. Orange arrows indicate that the tests in question were conducted referring to the period of the Naruto Incident; black arrows refer to either between 2005 and the incident or after 2012 (i.e., one year after the earthquake, avoiding the effects of the chaos immediately

[6] The results are shown in Appendix B and C. For some of these markets, the available data was overlapping the time period of the Naruto Incident. Since the incident made the price and supply series chaotic for a period, the results in the shaded area of the table must be considered influenced by the incident—and perhaps integrated as a result of this influence.

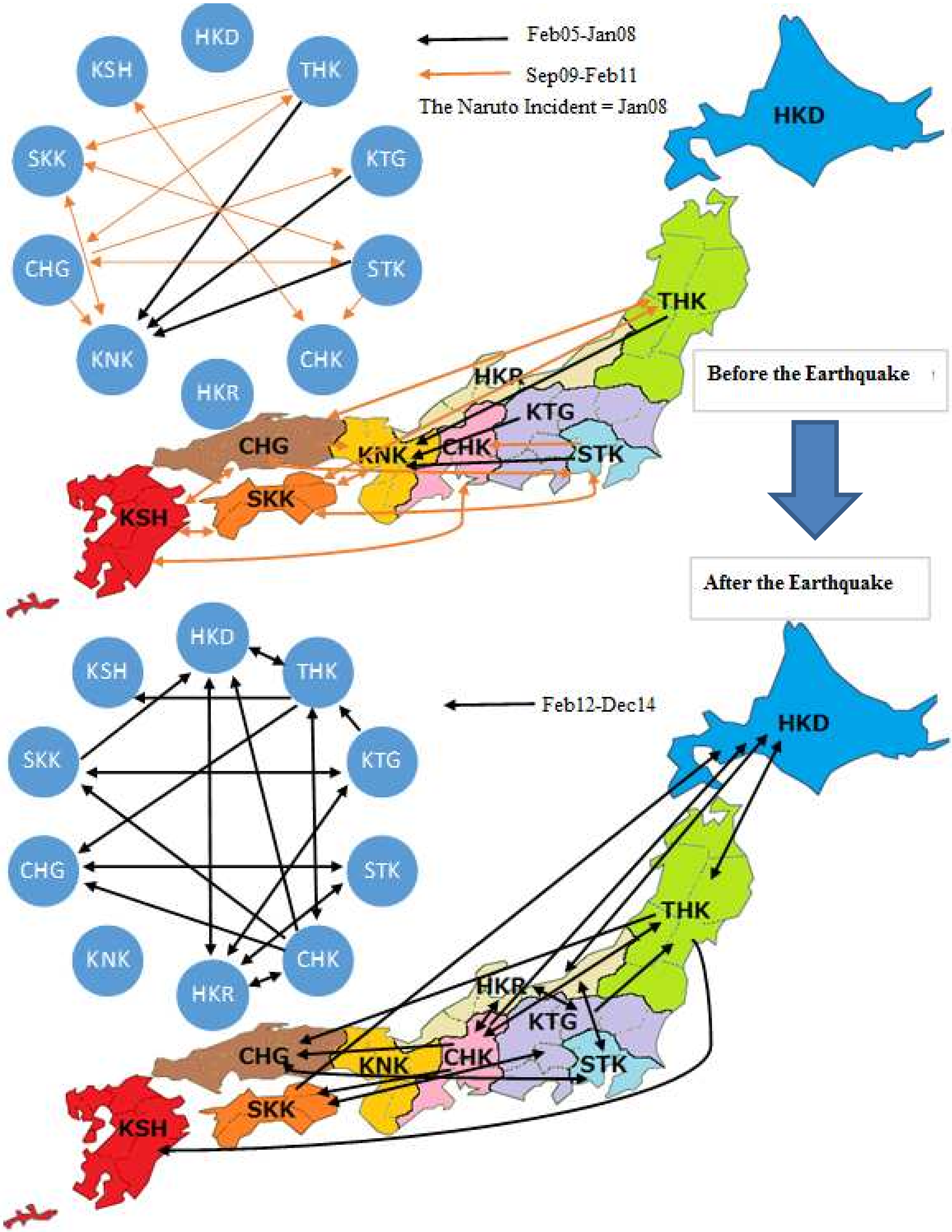


Figure 3. Relationships between the Regions before and after the Great East Japan Earthquake

following the earthquake). Arrows generally indicate the direction of influence on the other market. A one-way arrow indicates that the market has a one-way influence on the other market; a two-way arrow indicates that the two markets mutually influence one another.

In the figure referring to before the earthquake, the map illustrates that the Kinki and Chugoku regions (KNK and CHG) are the key junctions of the Sanriku wakame markets. This is because wholesalers reside in these regions and buy Sanriku wakame to meet their demands. In western Japan, in which KNK, CHG, SKK, and KSH are located, the markets are almost all mutually related to one another, and all markets seem to share the same wakame inventory. Orange arrows indicate that the relationship is limited to the time of the Naruto Incident. The scandal had a huge impact on the domestic market, and many retailers refunded customers for Naruto wakame due to the scam. Therefore, the logical interpretation is that during this period, the Naruto Incident led to linkages between Naruto city (SKK) and the other markets. In contrast, the Hokkaido region (HKD) is independent of the other markets.

In the figure referring to after the earthquake, the market relationship appears different. (Note that this is measured from one year after the earthquake (beginning in March 2012) until December 2014, so the temporal influence of the earthquake on the markets is less). One notable change is that the key junction role shifted from Kinki (KNK) region to Chukyo (CHK) region.

Kinki is now independent and uninfluenced by any other market, whereas Chukyo has become mutually influenced by Hokuriku (HKR) and Tohoku (THK). Also, Chukyo is price-leading Hokkaido (HKD), Shikoku (SKK), and Chugoku (CHG). It follows that Chukyo region now plays the role of a hub between eastern and western Japan. Hokkaido (HKD) and Hokuriku (HKR) are no longer independent. Hokkaido is a price follower of Chukyo and Shikoku and mutually influenced by Hokuriku because wakame demand surged in Hokkaido after the earthquake, probably due to back-up purchase for earthquake-recovery. Hokuriku is now linked to HKD, KTG, and CHK. Overall, the number of relationship arrows is greater in the post-earthquake period, indicating that the relationships have become more complicated than during the pre-earthquake period.

5. Discussion

Since the average wakame price in Kinki declined after the earthquake but total sales increased, we hypothesize that buyers started purchasing cheap, inferior wakame instead of conventional wakame. This conjecture is supported by anecdotal evidence. In particular, comments by the Iwate Prefectural Fisheries Association (JF Iwate) support our hypothesis, claiming that inferior wakame products recently produced by Miyagi prefecture (in THK) were being newly distributed in many places via unofficial channels, with many buyers no longer dealing with JF Iwate (Yamazaki 2015). The fact that Kinki utilized unofficial distribution channels is reflected in Figure 4 A smaller amount of inferior wakame was found in Kinki market before the earthquake, but once the market started transacting in inferior wakame, total sales increased. Wholesalers and retailers thus learned that inferior Sanriku wakame products were acceptable to Kinki consumers.

In the pre-earthquake market relationship, markets seemed integrated in western Japan, where Chugoku and Hyogo (in KNK) house large seaweed wholesalers, but after the earthquake they are no longer integrated. Also, most of the other market relationships became more complicated after the earthquake, largely because the distribution of inferior wakame products created a new distribution system independent of the conventional setup. Additionally, in 2011, Sanriku wakame was temporally unavailable, and buyers had to seek alternative wakame sources. Once buyers switched brands, they had no incentive to revert to the Sanriku brand. New sales chains developed in the domestic market after the earthquake, and these provided Sanriku wakame producers with important information that proved relevant to the market. A minor additional factor is that, seeing the major disaster being covered in the media, people started buying Sanriku products (Sawagami 2011).

6. Conclusion

The purpose of this study was to investigate the influence of the 2011 Japanese earthquake on domestic markets for wakame seaweed. The market integration analysis found that the market structure—i.e., the relationship between price leaders and followers—changed before and after the earthquake. In particular, we found that Iwate producers suffered from a price decrease due to an inflow of inferior products into Miyagi prefecture. Currently, most wakame products in both regions are sold as "Sanriku" brand; this poses a problem for the Iwate producers because both superior and inferior quality wakame is present in the same market. Miyagi producers, however, can only take advantage of the "Sanriku" brand. Both regions were heavily damaged by the earthquake and have since made their best efforts to recover from this devastation. One strategy that Iwate wakame producers can follow is to differentiate Miyagi wakame from Iwate wakame to maintain high prices. Thus, specific branding, such as using an "Iwate Sanriku" brand, is necessary for Iwate wakame producers to sell their products to consumers at a price premium.

In terms of directions for additional research, this study considered changes in market structure and price but not sales volume or consumption. Considering consumption, however, would also provide important insights. Further research should thus seek to determine whether the earthquake had a negative impact on sales or consumption.

Acknowledgements

This study was funded by JSPS Kakenhi Grant number 90722778 and the Agriculture, Forestry and Fisheries Research Council, Japan. Both organizations provided us with all necessary expenses to complete the project, for which we are very grateful.

References

Asche F, Bennear LS, Oglend A, Smith MD (2012) "U.S. Shrimp Market Integration," *Marine Resource Economics*, 27:181-192

Asche F, Bremnes H, Wessells CR (1999) "Product Aggregation, Market Integration, and Relationships between Prices: An Application to World Salmon Markets," *American Journal of Agricultural Economics,* 81:568-581

Asche F, Gordon DV, Hannesson R (2004) "Tests For Market Integration and the Law of One Price: The Market For Whitefish in France," *Marine Resource Economics,* 19:195-210

Asche F, Guttormsen AG, Sebulonsen T, Sissener EH (2005) "Competition between farmed and wild salmon: the Japanese salmon market," *Agricultural Economics,* 33:333-340

Bachmeier LJ, Griffin JM (2006) "Testing for market integration: crude oil, coal, and natural gas," *The Energy Journal,* 27:55-72

Bose S, McIlgorm A (1996) "Substitutability Among Species in the Japanese Tuna Market: A Cointegration Analysis," *Marine Resource Economics,* 11:143-155

Enders W (2004) *Applied Econometric Time Series. 2nd edn.* John Wiley & Sons, Inc,

Johansen S, Juselius K (1990) "Maximum-Likelihood-Estimation and Inference on Cointegration- with Applications to the Demand for Money," *Oxf Bull Econ Stat*, 52:169-210

Lüutkepohl H, Saikkonen P, Trenkler C (2001) "Maximum eigenvalue versus trace tests for the cointegrating rank of a VAR process," *Econometrics Journal,* 4:287-310

Miyata T, Lou X, Onodera M (2008) "The Competitive Power of Domestic Seafood in a Globalized Japanese Market: A case of Japanese," Wakame *Journal of Regional Fisheries,* 48:1-17

Nielsen M (2005) "Price formation and market integration on the European first-hand market for whitefish," *Marine Resource Economics,* 20:185-202

Norman-López A et al. (2013) "Price integration in the Australian rock lobster industry: implications for management and climate change adaptation," *Australian Journal of Agricultural and Resource Economics,* 58:43-59

Sawagami A (2011) "Livers, let's raise a revolusion by backup purchase (Japanese)," *Shukan Asahi*, 116:154-155

Wakamatsu H (2014) "The Impact of MSC Certification on a Japanese Certified Fishery," *Marine Resource Economics,* 29:55-67

Wakamatsu H, Miyata T (2015) "Purchasing Factors of Wakame Consumers: Using an Auction Experiment," *Nihon Suisan Gakkai shi* (InJapanese), 81:283-289

Yamazaki Y (2013) *An interview at JF Iwate.* Iwate

Yamazaki Y (2015) *An interview at JF Iwate.* Iwate

Appendices

Appendix A. Optimal Lags and Unit Root Tests

	Opt.	ADF				Phillips-Perron			
	Lags	Level		1st Diff.		Level		1st Diff.	
Hokkaido	1	-2.91		-7.49	***	-20.76		-75.08	***
Tohoku	1	-2.24		-6.84	***	-14.92		-79.91	***
Kanto	1	-4.22	***	-8.46	***	-30.16	***	-66.15	***
Metropolitan	1	-2.53		-6.58	***	-15.51		-69.89	***
Chukyo	1	-2.90		-6.02	***	-16.93		-65.08	***
Hokuriku	1	-2.80		-6.19	***	-19.87		-76.08	***
Kinki	1	-2.03		-8.10	***	-13.99		-78.78	***
Chugoku	1	-2.60		-7.63	***	-14.54		-72.15	***
Shikoku	5	-2.06		-7.20	***	-8.53		-69.95	***
Kyushu	2	-1.98		-6.47	***	-7.81		-80.97	***

*** indicates statistical significance at the 1% level.

Optimal lags are determined by the Schweitzer Bayesian Information Criteria (SBIC).

Appendix B. Multivariate Cointegration Tests Before and After the Earthquake

Rank		0	1	2	3	4	5	6	7
Before the Earthquake	Log-likelihood	-898.86	-872.66	-848.97	-834.90	-825.18	-819.60	-815.44	-815.44
	Eigenvalue	.	0.80	0.76	0.57	0.45	0.29	0.22	0.00
	Trace statistics	166.84*	114.45*	67.06	38.92	19.49	8.32	0.00	.
After the Earthquake	Log-likelihood	-899.30	-875.58	-856.07	-840.09	-829.15	-823.99	-821.35	-820.05
	Eigenvalue	.	0.76	0.69	0.62	0.48	0.27	0.15	0.08
	Trace statistics	158.49*	111.05*	72.03*	40.08	18.20	7.87	2.59	.

Note: Kanto-Rim, Chukyo, and Shikoku regions are excluded because some of the pre-earthquake observations are missing.

Appendix C. Bivariate Cointegration Tests

	Before the	Rank=0		Rank = 1			After the	Rank=0		Rank = 1		
Price	Earthquake	Max	Trace	Max	Trace	Rank	Earthquake	Max	Trace	Max	Trace	Rank
Bivariate												
HKD/THK	Feb05-Jan08	11.24	14.52	3.27	3.27	0	Feb12-Dec14	16.16	18.97	2.80	2.80	1
HKD/STK	Feb05-Jan08	9.78	12.71	2.93	2.93	0	Feb12-Dec14	20.38	25.31	4.93	4.93	Full
HKD/CHK	Sep09-Feb11	12.29	17.50	5.21	5.21	Full	Feb12-Dec14	11.06	16.15	5.09	5.09	Full
HKD/HKR	Feb05-Jan08	10.40	14.91	4.51	4.51	0	Feb12-Dec14	30.53	33	2.66	2.66	1
HKD/KNK	Feb05-Jan08	11.94	17.19	5.25	5.25	Full	Feb12-Dec14	41.07	30.53	4.68	4.68	Full
HKD/CHG	May09-Feb11	8.20	12.91	4.71	4.71	0	Mar12-Dec14	14.23	18.16	3.94	3.94	Full
HKD/SKK	Nov09-Feb11	13.44	20.09	6.65	6.65	Full	Jun12-Dec14	7.35	10.84	3.49	3.49	0
HKD/KSH	Feb05-Jan08	7.07	10.19	3.12	3.12	0	Feb12-Dec14	11.05	14.84	3.79	3.79	0
THK/STK	Feb05-Jan08	7.82	13.81	5.99	5.99	0	Feb12-Dec14	40.95	45.57	4.62	4.62	Full
THK/CHK	Sep09-Feb11	8.07	11.95	3.87	3.87	0	Feb12-Dec14	13.68	16.39	2.71	2.71	1
THK/HKR	Feb05-Jan08	10.53	15.44	4.91	4.91	Full	Feb12-Dec14	29.05	39.41	10.36	10.36	Full
THK/KNK	Feb05-Jan08	22.26	30.79	8.53	8.53	Full	Feb12-Dec14	15.83	25.72	9.90	9.90	Full
THK/CHG	May09-Feb11	16.22	19.46	3.24	3.24	1	Mar12-Dec14	23.52	36.94	13.42	13.42	Full
THK/SKK	Nov09-Feb11	18.41	18.80	0.38	0.38	1	Jun12-Dec14	7.99	14.06	6.08	6.08	0
THK/KSH	Feb05-Jan08	8.92	11.64	2.71	2.71	0	Mar12-Dec14	20.17	30.18	10.01	10.01	Full
STK/CHK	Sep09-Feb11	13.75	22.37	8.61	8.61	Full	Mar12-Dec14	20.47	25.68	5.22	5.22	Full
STK/HKR	Feb05-Jan08	10.05	15.94	5.90	5.90	Full	Feb12-Dec14	40.97	44.60	3.62	3.62	1
STK/KNK	Feb05-Jan08	15.06	21.43	6.37	6.37	Full	Feb12-Dec14	27.84	38.75	10.91	10.91	Full
STK/CHG	May09-Feb11	15.02	17.08	2.06	2.06	1	Mar12-Dec14	13.90	16.00	2.11	2.11	1
STK/SKK	Nov09-Feb11	13.59	14.76	1.16	1.16	0	Jun12-Dec14	8.19	10.23	2.04	2.04	0
STK/KSH	Feb05-Jan08	5.48	10.30	4.82	4.82	0	Feb12-Dec14	13.09	14.44	1.34	1.34	0
CHK/HKR	Sep09-Feb11	7.37	12.90	5.53	5.53	0	Feb12-Dec14	30.86	34.42	3.55	3.55	1
CHK/KNK	Sep09-Feb11	14.53	20.02	5.49	5.49	Full	Mar12-Dec14	19.30	24.40	5.10	5.10	Full
CHK/CHG	Sep09-Feb11	6.45	9.65	3.20	3.20	0	Mar12-Dec14	17.37	22.49	5.12	5.12	Full
CHK/SKK	Nov09-Feb11	11.93	12.89	0.96	0.96	0	Jun12-Dec14	8.57	12.33	3.77	3.77	0
CHK/KSH	Oct10-Feb11	17.98	18.38	0.40	0.40	1	Apr12-Dec14	8.05	12.64	4.59	4.59	0
HKR/KNK	Feb05-Jan08	13.71	21.83	8.12	8.12	Full	Feb12-Dec14	27.27	38.02	10.75	10.75	Full
HKR/CHG	May09-Feb11	9.51	11.55	2.04	2.04	0	Mar12-Dec14	15.92	23.24	7.32	7.32	Full
HKR/SKK	Nov09-Feb11	4.44	4.69	0.25	0.25	0	Jun12-Dec14	12.81	17.49	4.68	4.68	Full
HKR/KSH	Feb05-Jan08	10.15	13.77	3.62	3.62	0	Mar12-Dec14	11.10	18.77	7.67	7.67	Full
KNK/CHG	May09-Feb11	7.13	9.47	2.34	2.34	0	Mar12-Dec14	13.98	26.07	12.09	12.09	Full
KNK/SKK	Nov09-Feb11	13.81	15.18	1.38	1.38	0	Jun12-Dec14	14.03	21.33	7.31	7.31	Full
KNK/KSH	Feb05-Jan08	16.65	3.77	12.88	3.77	Full	Mar12-Dec14	11.86	22.16	10.30	10.30	Full
CHG/SKK	Nov09-Feb11	7.13	7.57	0.44	0.44	0	Jun12-Dec14	10.62	15.84	5.21	5.21	Full
CHG/KSH	Nov09-Feb11	8.18	10.42	2.24	2.24	0	Mar12-Dec14	13.80	23.71	9.91	9.91	Full
SKK/KSH	Nov09-Feb11	16.87	16.93	0.06	0.06	1	Jun12-Dec14	11.16	18.38	7.21	7.21	Full

The results included are based on a 5% significance level.

Shaded portions indicate the period after the Naruto Incident.