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Impact of Recent Crises and Disasters on Regional Production/Distribution Networks and Trade in Japan

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Abstract: *This paper sheds light on domestic/international production networks in machinery industries and examines how the economic crisis and natural/technological disaster that Japan encountered in recent years affected the networks and trade, mainly from the viewpoint of Japan's exports. More specifically, the paper first decomposes changes in machinery exports into extensive and intensive margins and then examines the probability of trade declines and recoveries, using a logit estimation, in order to capture the natures of international production/distribution networks under the crises, i.e., the 2008-2009 Global Financial Crisis (GFC) and the 2011 Great East Japan Earthquake (EJE). Discussion is also presented focusing on domestic activities as well as the impacts of the 2011 Thailand floods. Moreover, considering that the 2011 EJE is not only a natural disaster but also a technological disaster that seriously affected Japan's agriculture and food exports, the impacts on their exports are investigated as well. Our analyses suggest that, regardless of whether demand shock or supply shock, the economic/natural disasters revealed the stability and robustness of production networks in machinery sectors, though their negative impacts are severe and transmitted through production networks at the beginning. At the same time, our analyses draw various policy implications from the experiences of these crises.*

Keywords: International production/distribution networks, economic crisis and natural/technological disaster, Japan

JEL classification: F14, F23, L23

1. Introduciton

Japan has recently encountered several crises and disasters. First, Japan faced a worldwide economic crisis, namely the 2008-2009 Global Financial Crisis (GFC) that primarily started as a demand shock due to drastic falls in demand in the US and EU markets. The 2008-2009 GFC seriously affected the world economy including Japan and other East Asian countries, as well as international production/distribution networks, mainly in machinery industries in the region. Second, Japan experienced a natural and technological disaster in March 2011, i.e., the 2011 Great East Japan Earthquake (EJE). The 2011 EJE brought about a supply shock due to the devastation of production plants located in the disaster areas caused by the tsunami, and had negative impacts on domestic/international production networks. Moreover, the 2011 EJE was not a simple natural disaster; the Fukushima nuclear accident resulting from the Tsunami caused a serious technological disaster and significantly affected Japan's agriculture and food exports. Third, the Japanese economy suffered from another natural disaster that occurred in Thailand in October 2011 (the 2011 Thailand floods) because many Japanese firms have operations in the disaster areas of Thailand, playing important roles in supply chains.

Given the fact that serious negative impacts of these crises/disasters were transmitted through domestic/international production/distribution networks, some people, including researchers and government officials, claimed that production networks had revealed their vulnerability toward shocks. As Ando and Kimura (2012) demonstrate, by analyzing the impacts of the 2008-2009 GFC and the 2011 EJE on Japan's exports, however, international production/distribution networks rather demonstrated their resiliency in the face of these two massive shocks, despite their initial negative impacts.

This paper sheds light on domestic/international production networks in machinery industries and examines how these economic crises and natural disasters affected the networks, mainly from the viewpoint of Japan's exports. More specifically, the paper first decomposes changes in exports into "extensive and intensive margins", i.e.,the quantity effect, the price effect, the effect due to exiting products, and the effect due to new products entering the market, in order to capture the features of trade declines and recoveries resulting from the crises for machinery

parts and components and machinery final products. The paper also examines the probability of trade declines and recoveries, using a logit estimation, to formalize the natures of international production/distribution networks under the crises. Discussion is also presented focusing on domestic activities as well as the impacts of the 2011 Thailand floods. Furthermore, as mentioned above, the 2011 EJE was not only a natural disaster but also a technological disaster that seriously affected Japan's agriculture and food exports. The paper therefore also investigates the impacts on their exports as well.

The rest of the paper is organized as follows: section 2 describes the patterns of Japan's exports. Sections 3 and 4 provide analyses of reduction and recovery of machinery exports resulting from the 2008-2009 GFC and the 2011 EJE, using the decomposition approach as well as a logit estimation. Section 5 in turn focuses on agriculture and food exports and examines the impacts of the two crises, using the same methodologies used in the previous sections. Section 6 briefly investigates the impacts of the GFC and the EJE on domestic activities, and the impacts of the 2011 Thailand floods, using indices of industrial production, regional input-output tables, and the Japan External Trade Organization (JETRO) survey. Section 7 concludes the paper.

2. Patterns of Japan's Exports[1]

Figure 1 presents trends of Japan's real exports in US dollars for all products, machinery parts and components, and machinery final goods (in total and automobiles only) from January 2007 to October 2011.[2] While the figure clearly shows the existence of significant negative impacts from the 2008-2009 GFC on Japan's exports, it displays a V-shaped recovery for all products, particularly for machinery parts and components. East Asia is the most important destination for Japan's exports in machinery parts and components, and a very quick recovery of exports to East Asia contributes to the rapid recovery of Japan's exports in machinery parts and components (Table 1 and Figure 1).[3] In addition, East Asia is growing in terms of the value of exports as well as the share in total exports of machinery final products; the value in 2010 was 1.6 times as high as that in 2007, and the share increases from 22 % in 2007 to 30 % in 2010.[4] The corresponding value and share in

2010 for automobiles only (final products) doubled from those in 2007. With the GFC as a trigger, East Asia is gaining importance as a market for machinery final products, though the United States (US) and European Union (EU) remain as important markets.[5]

Figure 1: Japanese Real Exports by Region

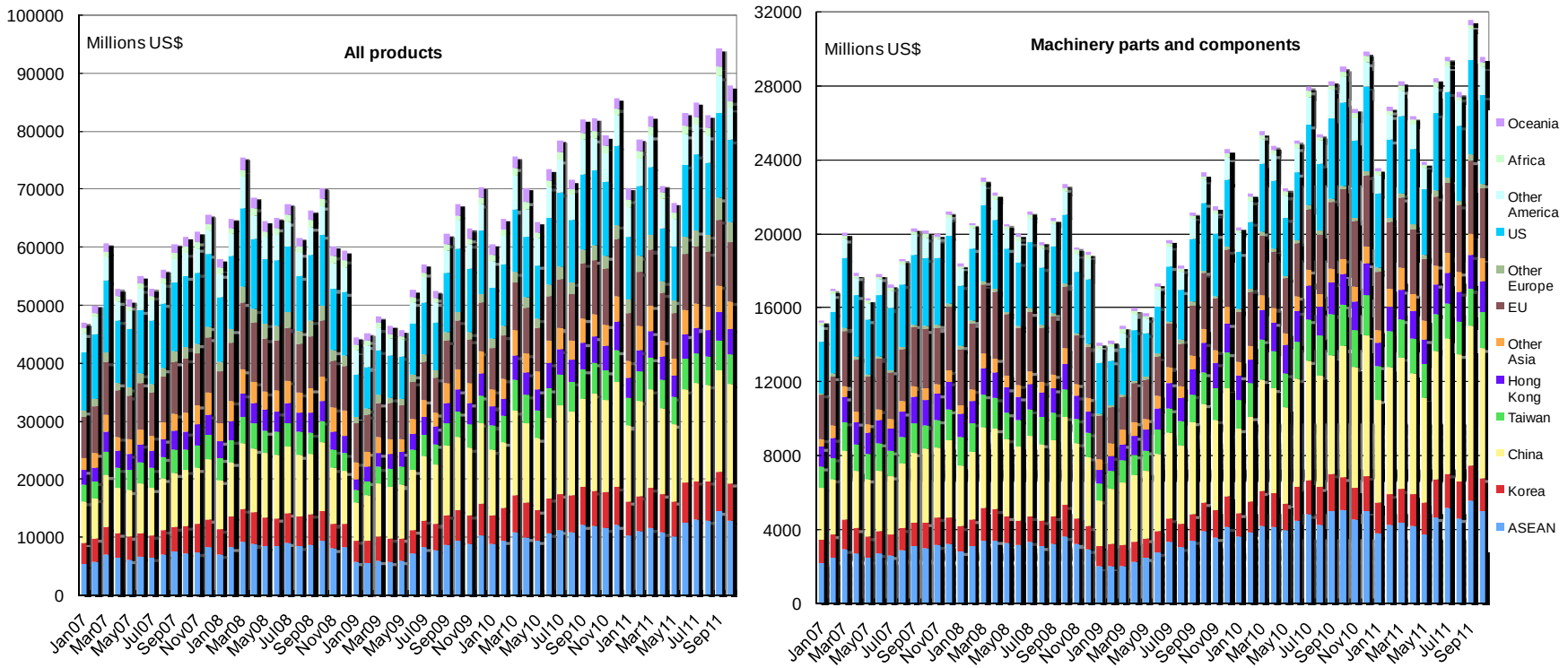
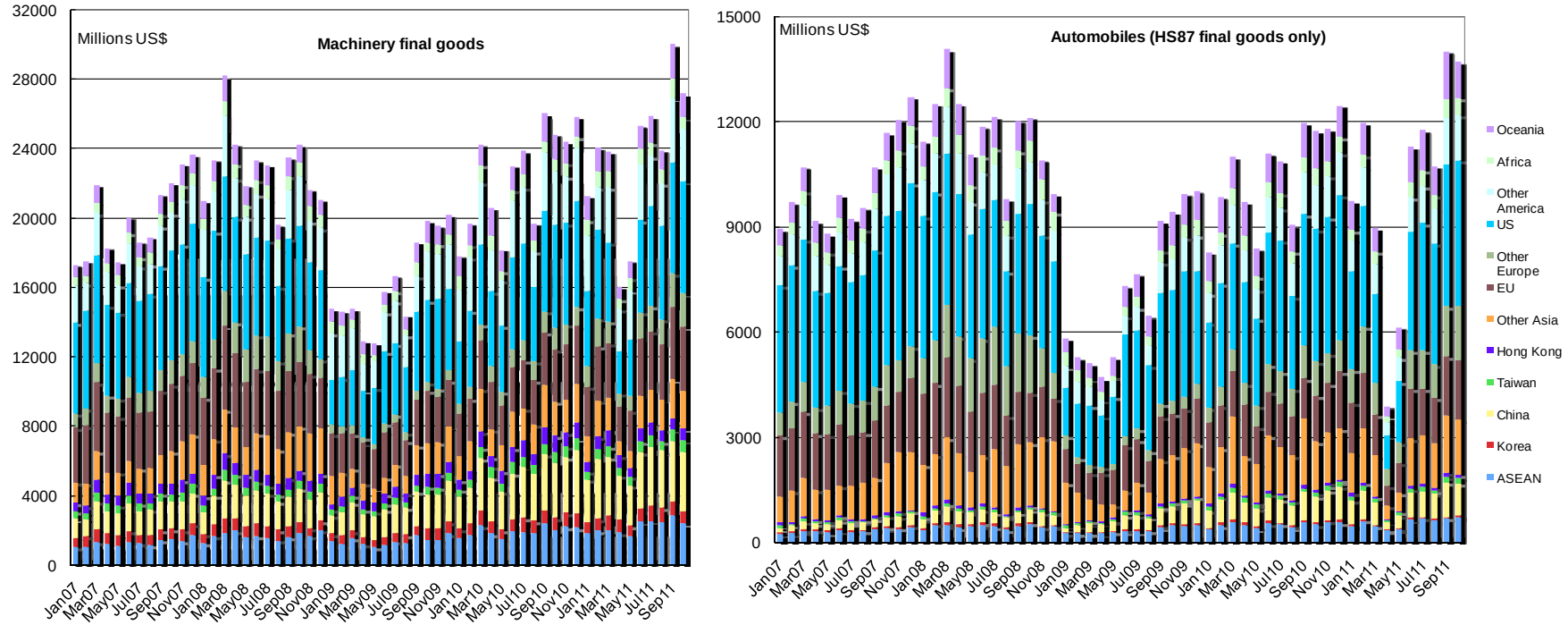


Figure 1: Japanese Real Exports by Region (Continued)



Data: Ando and Kimura (2012).

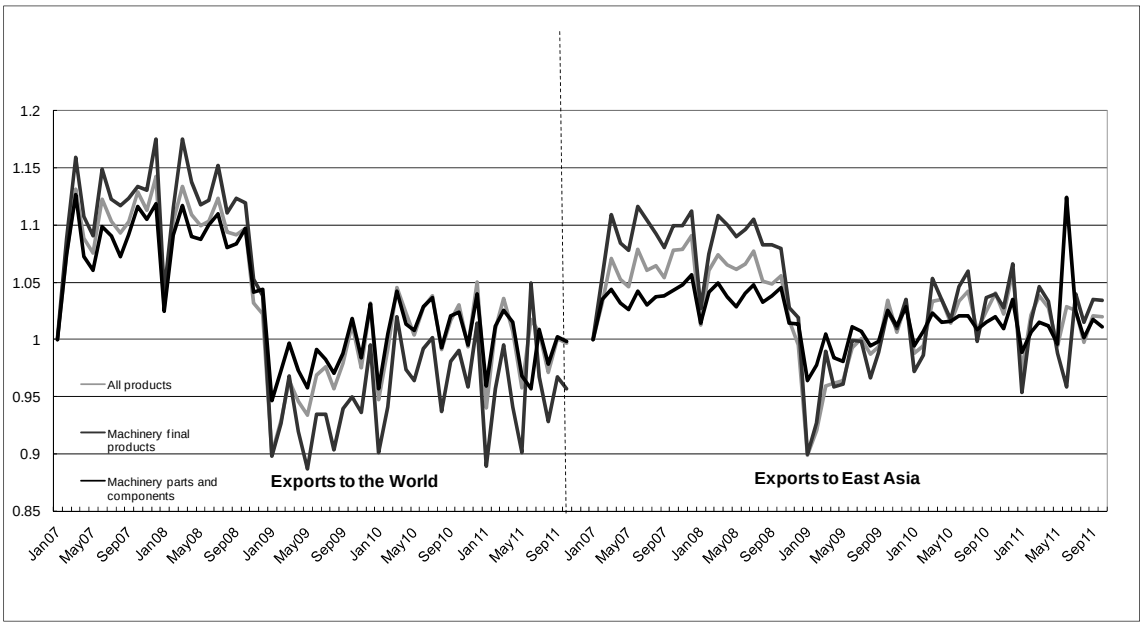
Table 1: By-region Values and Shares of Japan's Real Exports

Destinations	The value of exports, indexed to 2007=1				Share in total exports (%)			
	2007	2008	2009	2010	2007	2008	2009	2010
All products								
East Asia	1.00	1.18	1.09	1.53	47	48	53	54
US	1.00	1.01	0.78	1.01	20	18	16	15
EU	1.00	1.10	0.82	1.00	15	14	12	11
World	1.00	1.16	0.97	1.31	100	100	100	100
Machinery parts and components								
East Asia	1.00	1.13	1.06	1.54	56	56	59	62
US	1.00	1.04	0.85	1.13	18	17	16	15
EU	1.00	1.11	0.83	1.13	15	15	13	13
World	1.00	1.11	0.99	1.38	100	100	100	100
Machinery final products								
East Asia	1.00	1.19	1.02	1.55	22	23	28	30
US	1.00	0.97	0.66	0.86	29	24	23	22
EU	1.00	1.06	0.69	0.78	18	16	15	12
World	1.00	1.15	0.81	1.12	100	100	100	100
HS87 final goods only								
East Asia	1.00	1.38	1.20	2.00	7	8	12	14
US	1.00	0.96	0.64	0.86	37	31	34	31
EU	1.00	1.01	0.62	0.76	17	15	15	12
World	1.00	1.14	0.70	1.02	100	100	100	100

Note: export values are in USD.
Data: Ando and Kimura (2012).

While machinery export values *per se* recovered theirpre- GFC levels, there exists a permanent change in the "extensive margins" of machinery exports. The number of exported product-country pairs for all products exported to the world significantly dropped in the 2008-2009 GFC, with a minimum in January 2009 (Figure 2).[6] Although the number of exported product-country pairs has had a tendency to increase since January 2009, it has not returned to the level of 2007 or 2008. The number of product-country pairs for exports to East Asian countries only dropped significantly as well, though the decline was not as pronounced as in the case of exports to all countries in the world. These reflect the fact that the geographical distribution of activities by Japanese firms, including those in East Asia, was reshuffled and the basis of Japan's exports has been narrowed down with the GFC as a trigger.

Figure 2: The Number of Exported Product-country Pairs, Indexed to January 2007=1



Data: Ando and Kimura (2012).

The negative effects of the EJE are reflected in exports particularly in April and May 2011. Exports rapidly increased in June, however. achieving a positive growth in terms of both changes from the previous month and from the previous year. Compared with the 2008-2009 GFC, the magnitude of the fall in overall exports, including exports in machinery parts and components, was much smaller, recovery was more rapid, and no distinctive change in the extensive margins of exports is observed.

Machinery final product statistics depict a somewhat different picture; their exports suffered from both the GFC and the 2011 EJE, and exports of automobiles, in particular, were even lower in April 2011 than they were at theirlowest point resulting from the 2008-2009 GFC. As critical small and medium-sized enterprises (SMEs) were located in the disaster areas of the 2011 EJE, negative supply shocks affected exports through production chains. Exports of machinery final products, including automobiles, however, rapidly recoveredafter May and even exceeded the level of the previous year in June. There also seems to be very little evidence of any long term affect on their exports

3. Machinery Exports: Decomposition of Trade Reduction and Recovery

This section investigates patterns of trade reduction and recovery, using the decomposition approach. For the analysis of the 2008-2009 GFC, the paper sets the period of trade reduction from October 2008 to January 2009 and the period of trade recovery from January to October 2009. For the analysis of the 2011 EJE, this paper focuses on monthly changes, or changes from previous months, to capture features of trade movements within a short period.

3.1. Methodology and Data

The decomposition approach used in this section is the one proposed by Haddad, *et al.* (2010). As a first step, the category of a product exported to a given partner country is identified as "continuing", "entry", or "exit". If a product is exported to a given country in both period $t-1$ and period t, the category of the product for the corresponding country (the product-country pair) is defined as "continuing". Similarly, the category is defined as "entry" if the product is exported only in t, and the category is defined as "exit" if the product is exported to the corresponding country only in $t-1$. Changes in export values from period $t-1$ to period t are then decomposed into extensive and intensive margins, based on the categories defined above. Intensive margins are composed of effects due to changes in quantity and price; that is, changes in export values for country-product pairs in the category "continuing" due to changes in quantity (the quantity effect) and changes in price (the price effect). On the other hand, extensive margins consist of an effect due to exiting products (exit effect hereafter) and an effect due to new products (entry effect hereafter); that isreduction in export values due to no exports in t for product-country pairs in the category "exit", and an increase in export values due to new exports in t for product-country pairs in the category "entry". According to the decomposition approach, the percentage change in the total value of exports can be expressed as the sum of the quantity effect, the price effect, the entry effect, and the exit effect:

$$\frac{dv_t}{v_{t-1}} = \frac{\sum_{c=1}^{C} \frac{p_t^c + p_{t-1}^c}{2} \Delta q_t^c}{v_{t-1}} + \frac{\sum_{c=1}^{C} \Delta p_t^c \frac{q_t^c + q_{t-1}^c}{2}}{v_{t-1}} + \frac{\sum_{n=1}^{N} p_t^n q_t^n}{v_{t-1}} - \frac{\sum_{x=1}^{X} p_{t-1}^x q_{t-1}^x}{v_{t-1}} \quad (I = C + N + X)$$

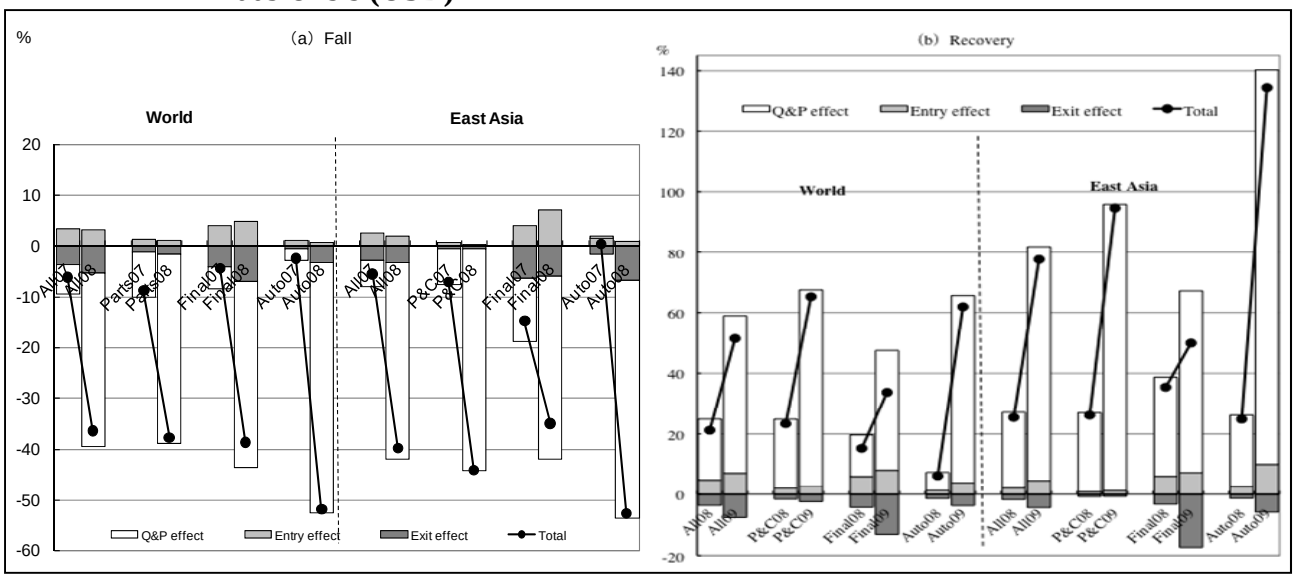
where v_t stands for the total value in t, which is the sum of value of each product i, c for products that are traded in both $t-1$ and t (in the category "continuing"), n for products that are traded only in t (in the category "entry"), x for products that are traded only in $t-1$ (in the category "exit"), I for the total number of products, C for the total number of products in the category "continuing", N for the total number of products in the category "entry", and X for the total number of products in the category "exit".

To decompose changes in values of Japan's exports by applying this method, monthly data of Japanese bilateral exports at the most disaggregated level or the Harmonized System (HS) 9-digit level, which are available from the Trade Statistics of Japan, the Ministry of Finance, Japan, are employed.[7] The nominal export values in Japanese Yen are converted into real export values in US dollars, using an export price index, available from the Bank of Japan, and exchange rates that are the monthly average of public rates announced by Japan Customs, available from the Ministry of Finance, Japan.

3.2. Results[8]

Figure 3 represents export changes during the periods of trade reduction and recovery, together with export changes in the same period of the previous year, to partially consider seasonal fluctuations. The figure clearly demonstrates that exports declined from October 2008 to January 2009 by almost 40 %. Even in normal years, Japanese exports tend to fall from October to January; for instance, exports declined in the same period of the previous year by 5 to 10 %. A 40 % drop, however, is certainly far beyond a drop due to seasonality. In particular, exports of automobiles dropped by more than 50 %, which is much larger than the decline in the same period of the previous year (3 %). The 2008-2009 GFC therefore did have significant negative impacts on Japanese exports.

Figure 3: Decomposition of Changes in Japanese Real Exports under the 2008-2009 crisis (USD)



Notes: Q&P effect is the sum of quantity effect and price effect. All08 (All07) for (a) Fall and All09 (All08) for (b) recovery, for instanec, denote all products in the priod from October 2008 to January 2009 and in the period from January to October 2009 (2008). P&C, Final, and Auto denote machinery parts and components, machinery final goods, and automobiles (HS87 final only).

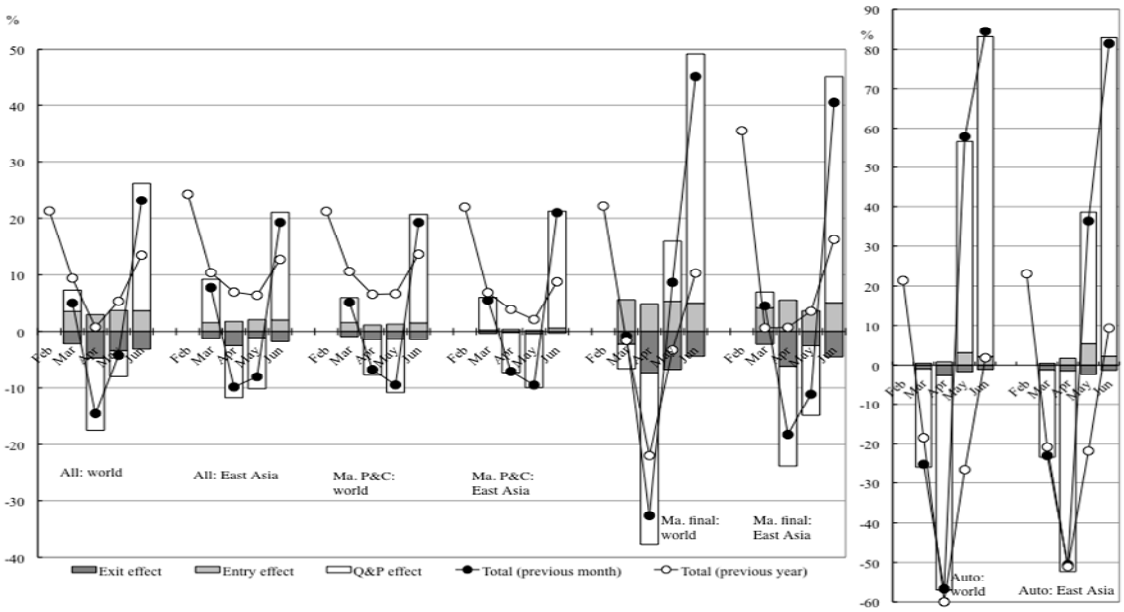
Data: author's preparation, based on the results in Ando and Kimura (2012).

The figure also demonstrates that the exit effect is much smaller in absolute terms for machinery parts and components than for other products; the exit effect is only -1.6 % for the world. Moreover, the exit effect is even smaller for East Asia with -0.7 %, and is almost at the level of the same period of the previous year. Although large intensive margins induced a significant decline in their exports, particularly for East Asia, such a small exit effect suggests the robustness of trade relationships for machinery parts and components within dense production/distribution networks in the region. Furthermore, the pattern of export recovery shows a symmetric picture to the export fall; the extensive margin was quite small, and a large positive quantity effect was observed for machinery parts and components exported to East Asia.

Figure 4 in turn represents monthly changes in real exports to the world after the EJE from March to June 2011, and the change in real exports to East Asia only. Unlike the GFC, monthly changes, i.e., changes from the previous month are decomposed into extensive and intensive margins, since drastic fluctuations in a

short period are observed. Similarly to the analysis for the GFC, however, changes from the corresponding month of the previous year (changes from previous year) are also considered, as monthly changes tend to be significantly influenced by seasonality.

Figure 4: Decomposition of Changes in Japanese Real Exports under the 2011 EJE (USD)



Data: author's preparation, based on the results in Ando and Kimura (2012).

As is the case of the GFC, the exit effect is much smaller for machinery parts and components than for other products: the exit effect is only around -1.5 % in a month. Moreover, the exit effect for machinery parts and components is more or less equal to the low level in the same month of the previous year, 2010. Although their exports decreased in April and May 2011, they significantly expanded in June 2011, reflecting a large and positive quantity effect. As a result, exports in June 2011 exceeded those in June 2010 by 14 %. Furthermore, the exit effect was even smaller for East Asia, i.e., less than -0.5 % in a month, compared with other regions. These findings suggest that trade relationships for machinery parts and components are robust, and that firms prioritize international production networks even following the EJE, just as is the case of the GFC.

On the other hand, exports in machinery final goods substantially declined in April 2011 by a greater extent than machinery parts and components, mainly due to a

significant negative quantity effect as well as an exit effect. A dramatic recovery was seen, however, in May and June. The outstanding recovery can be observed particularly for automobiles. Exports of automobiles drastically declined in April by around 60 % from the previous month,and from the same month of the previous year, mostly due to a negative quantity effect, which fell even below the minimum level of exports following the GFC. Although exports were negatively affected through production chains, because some of the critical SMEs are located in the disaster areas, they mostlyreturned to the level of the previous year in June. Behind such a dramatic recovery for automobiles, there were great "private" efforts to restore supply chains by private companies. One symbolic episode is the case of Japan Renesas. This company was producing several key electronic parts and components called micro-processing units (MPU), memory control units (MCU), and application specific standard products (ASSP) for automobiles and various ICT products. The EJE severely damaged its factories, including the Naka Factory in Ibaraki Prefecture. In order to resume their supply chains, the Japan Automobile Manufacturers Association (JAMA) and others gathered workers from a number of companies and sent them to the Naka Factory to help restore the operation; the number of such helpers exceeded 2,500 a day at maximum. Thus a strong incentive to maintain the supply chains worked even beyond the boundaries of individual firms, even if negative impacts were transmitted through the supply chains at the beginning of the crisis.

4. Machinery Exports: Probability of Trade Fall and Recovery

To formalize the features of machinery exports in responding to the crises, this section first investigates probability of reduction and recovery of machinery exports resulting from the two crises, using a logit estimation.

4.1.Methodology and Data

For the analysis of trade reduction as a result of the 2008-2009 GFC [the 2011 EJE], those product-country pairs at the HS 9-digit level with exports in October

2008 (and/or one-month before and after) [March 2011 (and/or one-month before and after)] are employed to examine whether or not their exports existed in January 2009 [May 2011]. For the analysis of trade recovery under the GFC [the EJE], on the other hand, those product-country pairs at the HS 9-digit level with exports in October 2008 (and/or one-month before and after) [March 2011 (and/or one-month before and after)] and no exports in January 2009 [May 2011] are used to investigate whether their exports recover by October 2009 [July 2011].

The equation for our logit estimation analyses is as follows:

$$EXchange_{i,j} = \beta_0 + \beta_1 \ln Dist_i + \beta_2 Parts_j + \sum_n^N \alpha_n Country_n + \varepsilon,$$

where $EXchange_{i,j}$ is a binary variable representing fall/recovery of exports; $EXchange_{i,j}$ is 1 if no export of product j to country i is observed in January 2009 [May 2011] and 0 otherwise for the analysis of trade fall at the 2008-2009 GFC [the 2011 EJE]. In contrast, $EXchange_{i,j}$ is 1 if exports of product j to country i are observed in October 2009 (July 2011) and 0 otherwise for the analysis of trade recovery under the 2008-2009 GFC (the 2011 EJE). $\ln Dist_i$ denotes the distance between Japan and country i in the form of a natural logarithm. $Parts_j$ is 1 if product j is machinery parts and components, and 0 otherwise. In addition, country/region dummies expressed as $Country_n$ are included for 14 East Asian countries, the US, and EU to capture the features of trade relationships with these countries/region at the crises.

4.2. Results

Given the control for distance, the results in Table 2 imply that machinery parts and components trade is less likely to be discontinued and is likely to recover even if it stops once, regardless of whether due to demand shock or supply shock. The coefficient for parts is negative for the analysis of trade fall and positive for the analysis of trade recovery with statistical significance, suggesting robust trade relationships for machinery parts and components, compared with machinery final products. This is consistent with the results of the decomposition analysis.

Table 2: Probability of Trade Relantionships of Japan's Machinery

	2008-2009 GFC				2011 EJE			
	Fall		Recovery		Fall		Recovery	
Distance (log)	-0.05	(-1.55)	0.10	(1.84) *	-0.14	(-3.87) ***	0.11	(1.98) **
Parts	-0.51	(-25.78) ***	0.28	(8.84) ***	-0.47	(-22.3) ***	0.06	(1.79) *
Korea	-1.37	(-13.54) ***	1.38	(8.54) ***	-1.88	(-16.69) ***	0.96	(5.01) ***
China	-1.74	(-18.85) ***	1.20	(7.70) ***	-2.11	(-20.4) ***	0.89	(4.81) ***
Taiwan	-1.31	(-14.91) ***	1.05	(7.31) ***	-1.69	(-17.32) ***	0.95	(5.63) ***
Hong Kong	-1.35	(-16.16) ***	0.91	(6.54) ***	-1.58	(-17.12) ***	0.74	(4.56) ***
Viet Nam	-0.96	(-12.11) ***	1.38	(10.92) ***	-1.30	(-15.00) ***	0.87	(5.85) ***
Thailand	-1.53	(-19.32) ***	1.11	(8.11) ***	-1.76	(-19.8) ***	0.79	(4.91) ***
Singapore	-1.39	(-17.88) ***	0.68	(4.92) ***	-1.39	(-16.82) ***	0.77	(5.29) ***
Malaysia	-0.91	(-12.33) ***	0.92	(7.69) ***	-1.18	(-14.38) ***	0.77	(5.46) ***
Brunei	0.88	(4.17) ***	-0.75	(-2.38) **	1.02	(4.05) ***	-0.38	(-1.16)
Philippines	-0.99	(-12.17) ***	1.03	(7.90) ***	-1.18	(-13.38) ***	0.33	(2.10) **
Indonesia	-0.91	(-12.41) ***	0.86	(7.19) ***	-1.15	(-14.31) ***	0.83	(5.96) ***
Cambodia	0.76	(4.08) ***	0.30	(1.45)	0.43	(2.75) ***	0.12	(0.55)
Laos	0.53	(1.86) *	-1.05	(-1.99) **	0.67	(2.24) *	-1.79	(-2.46) **
Myanmar	0.35	(2.21) **	0.12	(0.58)	0.06	(0.39)	-0.03	(-0.12)
US	-1.99	(-23.37) ***	0.37	(2.18) **	-1.78	(-20.61) ***	0.52	(3.22) ***
EU	-0.53	(-22.05) ***	0.07	(1.78) *	-0.50	(-19.43) ***	0.14	(3.23) ***
Constant	0.93	(2.89) ***	-2.09	(-4.38) ***	1.53	(4.48) ***	-2.06	(-3.89) ***
Log likelihood	-29744		-11949		-26132		-9749	
Number of observatior	45979		20507		41827		16221	

Notes: dependent variable for the analysis of trade fall is 1 if trade stops and 0 otherwise. Similarly, dependent variable for the analysis of trade recovery is 1 if trade recovers and 0 otherwise. Figures in parenthesis are z-statistics. *** indicates that the results are statistically significant at the 1 % level, ** at the 5 % level, and * at the 10 % level.

Data: Ando and Kimura (2012).

The results also indicate that, among East Asian countries, those who are heavily involved in the regional production networks tend to maintain their trade relationships and tend to recover trade even if they stopbriefly. The coefficients for East Asian countries are mostly negative for the analysis of trade fall and positive for the analysis of trade recovery with statistical significance. In particular, the absolute values of coefficients for countries such as China, Thailand, Korea, Taiwan, and Vietnam are large for the analysis of the GFC, indicating the strong trade relationships in the production networks. Similarly, the absolute values of coefficients for countries such as China, Korea, Thailand, Taiwan, and Vietnam are large for the analysis of the EJE. On the other hand, the coefficients for countries such as Brunei, Cambodia, Laos, and Myanmar are either statistically insignificant, small in absolute terms, or even opposite. This implies that these countries are not deeply involved in regional production networks in machinery industries.

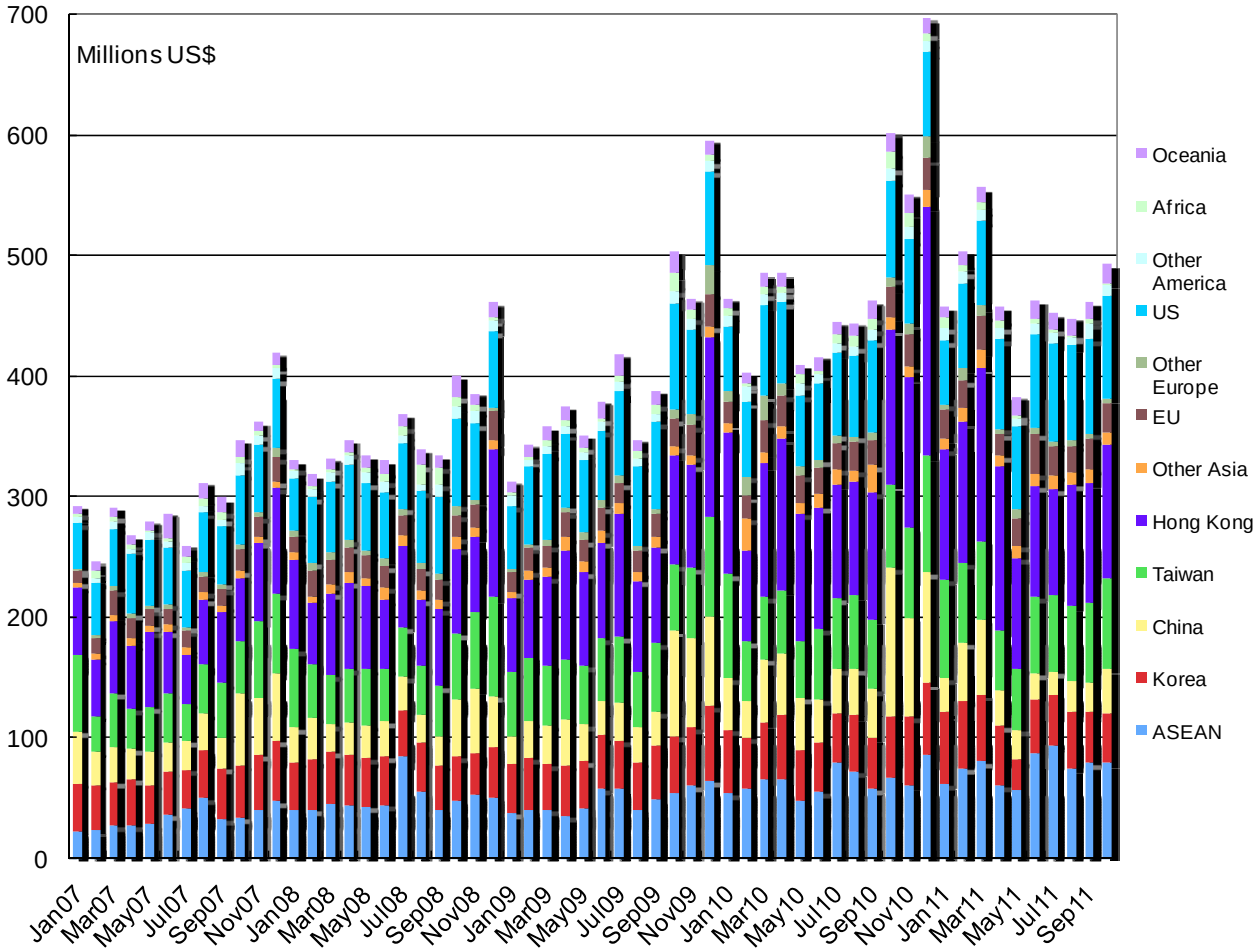
In addition to the logit analysis mentioned above, Ando and Kimura (2012)

conduct a survival analysis to investigate the long term probability of trade recovery, considering the timing of recovery. Their results also demonstrate that trade in machinery parts and components has a lower probability of being discontinued and has a higher probability of recovery even if briefly stopped. All findings in this section confirm that regional production networks are resilient against shocks to save transaction costs of firms' setting-up production networks even if negative impacts are transmitted through the production networks at the outset of a crisis.

5. Agriculture and Food Exports

Unlike other commodities, destinations of exports in agriculture and food products are limited to specific countries/regions; major destination countries/regions are Hong Kong (24 % of total exports in 2010), the US (14 %), ASEAN (13 %), Taiwan (13 %), China (11 %), Korea (10 %), and the EU (5 %), accountingfor 90 % of the total (Figure 5). In addition, the seasonality is typical for exports in agriculture and food products, with a peak in December every year mainly due exports to Hong Kong.

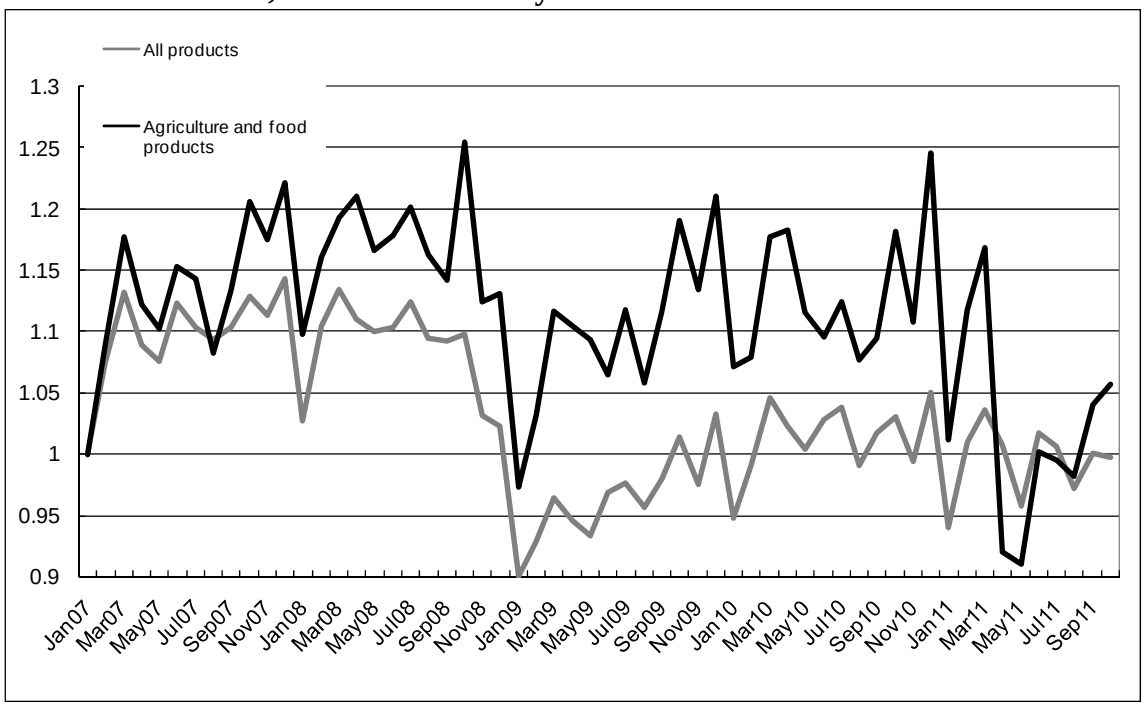
Figure 5: Japanese Real Exports in Agriculture and Food Products by Region



Data: author's calculation, using data available from the Ministry of Finance and the Bank of Japan.

While agriculture and food exports seem to have been less affected by the 2008-2009 GFC, they were significantly affected by the Fukushima nuclear accident caused by the Tsunami component of the 2011 EJE. The negative impacts of this technological disaster are clearly shown in a significant decline of exports in April and May; exports in April and May declined from the respective previous month by almost 20 %. The negative impacts are also reflected in the number of exported product-country pairs; the number for agriculture and food products drastically decreased in April and May, though the seasonality is stronger than other products (Figure 6).

Figure 6: The Number of Exported Product-country Pairs for Agriculture & Food Products, Indexed to January 2007=1

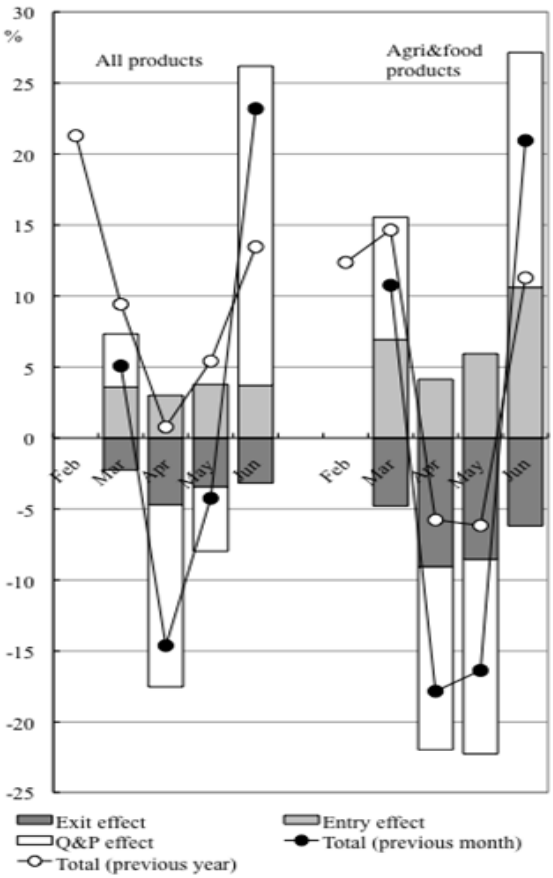


Data: author's calculation, using data available from the Ministry of Finance.

The decomposition of trade reductions resulting from the EJE demonstrates that the serious decline in agriculture and food exports in April and May 2011 was largely induced by the exit effect or the effect by products for which exports discontinued, in addition to the negative quantity effect (Figure 7); the exit effect explains half of the export decline. Many countries introduced safety inspections and trade restrictions in various ways, including the obligation of submitting certificates of

inspection for radioactive materials and/or certificates of origin at the prefecture level, sampling inspection on the import side, and import prohibition, for imports in agriculture and food products produced in Japan. Besides safety inspections and trade restrictions, there seem to have been exit blows from unfounded (but partially understandable) rumors induced by the nuclear disaster. Most of the major partner countries/regions also introduced import prohibition for specific agricultural and food products produced in specific prefectures (all products produced in specific areas in the case of China and Taiwan), in addition to the obligation of submitting certificates of origin and safety inspection. The effects of these trade restrictions are directly reflected in the significant reduction of exports.

Figure 7: Decomposition of Changes in Exports to the World in Agriculture and Food Products under the 2011 EJE(USD)



Data: author's calculation, using data available from the Ministry of Finance and the Bank of Japan.

Table 3 confirms how the number of exported products declined in each country/region. Even if the trend in the previous year is considered, the number of exported products is indeed low particularly for May and June in China (0.60 and 0.54, respectively), May in Korea (0.65), April in the EU (0.63), and April and May in the Middle East (0.59 and 0.65).[9] On the other hand, an upward trend is observed by June for some countries such as Korea and the EU, and also the reduction is rather marginal in terms of the number of products exported to the US and the ASEAN 10. As a result, agriculture and food exports were rapidly recovering in June.

Table 3: The Number of Exported Agriculture and Food Products for Selected Countries/region in 2011

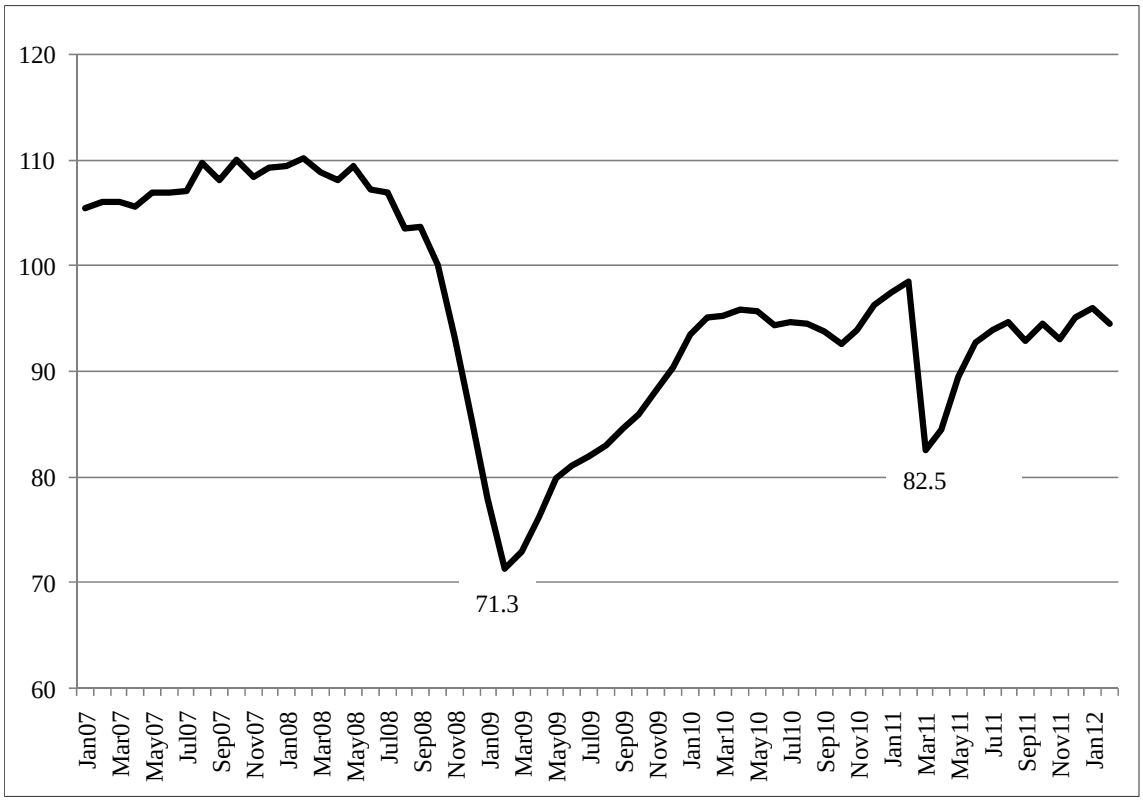
Destination	Share in total	The number of exported products							
		March		April		May		June	
Hong Kong	24%	1.03	(1.00)	0.95	(1.05)	0.92	(1.08)	0.97	(1.03)
US	14%	1.05	(1.14)	1.02	(1.12)	1.01	(1.08)	1.03	(1.04)
ASEAN10	13%	1.34	(1.31)	1.12	(1.30)	1.10	(1.19)	1.25	(1.24)
Taiwan	13%	0.95	(0.90)	0.87	(0.96)	0.83	(0.95)	0.84	(0.90)
China	11%	1.06	(1.04)	0.80	(1.04)	0.60	(1.03)	0.54	(1.06)
Korea	10%	0.95	(0.95)	0.98	(1.00)	0.65	(0.86)	0.81	(0.91)
EU27	5%	1.18	(1.24)	0.63	(1.33)	0.95	(1.15)	1.02	(1.00)
Middle East	2%	1.76	(1.57)	0.59	(1.35)	0.65	(1.61)	0.78	(1.37)

Notes: The number of exported products is indexed to January 2007. The figures in parenthesis are those for 2010. The shares are based on export values in 2010.
Data: author's calculation, using data available from the Ministry of Finance.

6. Domestic Activities and the 2011 Thailand Floods

While previous sections in this paper focus on the patterns of exports, this section briefly investigates domestic activities from the perspective of industrial production and regional input-output tables.[10] As with the patterns of exports, the index of industrial production for the whole Japan suggests that the direct impacts of the 2008-2009 GFC were more serious than those of the 2011 EJE (Figure 8). As Figure 9 clearly displays, the impacts of the EJE are indeed more serious if analysis is focused only on the disaster areas.[11] The magnitude of the direct impacts of the GFC, however, was more serious, at least from the perspective of production as well as exports for the whole country.

Figure 8: Indices of Industrial Production: Manufacturing (2005=100)



Data: author's preparation, based on data available from the METI (http://www.meti.go.jp/english/statistics/tyo/iip/index.html)

Figure 9: Indices of Industrial Production by Disaster and Non-disaster areas: Mining and Manufacturing (2005=100)

Data: METI (2012).

Production activities in the disaster areas are of course connected with those in other areas. Table 4 shows regional connections of production activities in terms of output in 2005: regional shares of demand for the production in the Tohoku (Northeast) region that had significant direct damage from the Tsunami. In many of the machinery sectors, a large portion of the products produced in the Tohoku region go to the Kanto region (where Tokyo is located): 51 % for office electric appliance, 49 % for industrial electric machinery, 40 % for household electrical machinery, 42 % for communication electronics equipment, and 55 % for auto parts. In the case of other transport equipment, 20 % of the products go to the Chubu region (where Toyota is located).

Table 4: By-region Demand for Products produced in the Tohoku Region

Sector	Mfg production in Tohoku	Regional shares of demand for the production in Toyoku by sector (%)							
	Sectoral shares	All regions	Hokkaido	Tohoku	Kanto	Chubu	Kinki	Chugoku-Shikoku	Kyushu&Okinawa
1 Food and beverage	18.6	100.0	5.2	45.4	34.3	4.6	5.9	2.2	2.5
2 Texitile	0.2	100.0	0.5	56.1	26.8	1.6	6.4	3.0	5.6
3 Apparel	1.8	100.0	3.3	14.3	64.4	7.6	5.6	2.5	2.3
4 Timber and wooden products	2.7	100.0	2.4	42.8	42.6	6.1	4.8	0.6	0.7
5 Pulp and paper	4.1	100.0	2.1	47.8	33.1	4.1	10.6	1.2	1.0
6 Printing and publishing	1.5	100.0	0.2	88.0	11.2	0.2	0.1	0.3	0.1
7 Basic industrial chemicals	1.3	100.0	2.5	57.2	29.6	4.7	2.9	1.5	1.7
8 Synthetic resins and fiber	0.2	100.0	0.2	74.6	20.1	1.0	2.7	0.9	0.5
9 Other chemical products	1.1	100.0	2.7	34.1	40.4	4.7	9.7	4.8	3.5
10 Drugs and medicine	2.7	100.0	2.1	40.7	23.8	4.7	18.5	5.0	5.1
11 Petroleum and petro products	3.0	100.0	4.3	71.2	23.6	0.1	0.2	0.6	0.0
12 Plastic products	2.9	100.0	1.3	50.7	31.2	6.0	6.7	2.3	1.7
13 Cement and cement products	3.2	100.0	1.4	58.5	23.2	5.5	5.9	2.0	3.5
14 Iron and steel	3.3	100.0	0.6	54.1	27.5	4.2	4.8	7.6	1.2
15 Non-ferrous metal	3.6	100.0	1.0	45.2	39.0	4.8	5.3	3.7	1.0
16 Metal products	4.0	100.0	2.7	43.9	38.2	6.2	4.6	2.4	2.0
17 General machinery	6.1	100.0	1.3	44.0	34.5	6.6	5.8	3.0	4.7
18 Office electric appliance	1.3	100.0	0.5	34.8	50.8	11.9	1.5	0.2	0.4
19 Industrial electric machinery	1.7	100.0	0.6	34.7	49.3	3.3	3.3	7.0	1.8
20 Other electric machinery and appliance	2.6	100.0	1.0	47.6	33.0	6.2	5.2	3.5	3.5
21 Household electrical machinery	0.2	100.0	4.3	32.0	39.9	6.2	7.8	5.1	4.6
22 Communication electronics equipment	5.6	100.0	2.3	26.7	42.1	6.0	10.4	5.4	7.2
23 Electronic computing equipment	4.8	100.0	1.1	54.2	27.6	6.9	3.6	4.6	2.0
24 Electronic parts	11.1	100.0	0.9	61.0	26.4	5.0	2.7	1.8	2.2
25 Passenger cars	2.1	100.0	1.0	66.2	18.5	4.3	5.1	1.9	3.0
26 Other motor vehicles	0.0	100.0	19.4	41.9	17.0	0.9	4.0	9.8	7.0
27 Auto parts	4.3	100.0	0.0	28.8	55.1	6.6	2.6	0.9	5.9
28 Other transport equipment	0.6	100.0	2.9	56.2	16.2	19.6	1.8	0.8	2.6
29 Precision machinery	2.3	100.0	2.5	40.4	30.1	5.3	10.5	6.1	5.1
30 Other manufacturing products	3.2	100.0	2.9	44.2	29.2	14.8	3.3	2.0	3.5

Note: figures for Tohoku are the sum of intra-regional demand and net exports.
Data: author's calculation, based on the regional input-output table in 2005 (the version with 53 sectors).

Table 5, on the other hand, presents the regional connections of production activities in terms of input in 2005: that is, the shares of manufacturing inputs from the Tohoku region in the production of machinery sectors for all regions as well as the Kanto region. In machinery sectors, the manufacturing input from the Tohoku region is large: in particular, in sectors of communication electronics equipment, electronic computing equipment, and electronic parts, the Tohoku region has a share of 10 % of the production in the whole Japan. Interestingly, electronic parts produced in the Tohoku region are used in various machinery sectors. Moreover, auto parts produced in the Tohoku region are used in various transport equipment sectors, though the portion of input is smaller than in the case of electric machinery sectors.

Table 5: Shares of Manufacturing Direct Inputs from the Tohoku Region in the Production of Machinery Sectors: All Regions and the Kanto Region

(%)

Sector	All regions													Kanto region											
	17	18	19	20	21	22	23	24	25	26	27	28	29	17	18	19	20	21	22	23	24	25	26	27	28	29
1 Food and beverage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Texitile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Apparel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Timber and wooden products	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Pulp and paper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 Printing and publishing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 Basic industrial chemicals	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8 Synthetic resins and fiber	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Other chemical products	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Drugs and medicine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 Petroleum and petro products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Plastic products	0.0	0.2	0.1	0.3	0.1	0.4	0.3	0.2	0.1	0.0	0.1	0.0	0.3	0.0	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.1
13 Cement and cement products	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2
14 Iron and steel	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.5	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0
15 Non-ferrous metal	0.1	0.0	0.3	0.8	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.0	0.2	0.1	0.0	0.2	0.3	0.2	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.1
16 Metal products	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.1
17 General machinery	0.7	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
18 Office electric appliance	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19 Industrial electric machinery	0.1	0.1	0.5	0.0	0.1	0.1	0.2	0.0	0.1	0.1	0.2	0.0	0.1	0.2	0.1	0.8	0.0	0.1	0.0	0.1	0.0	0.3	0.1	0.3	0.1	0.0
20 Other electric machinery and appliance	0.0	0.1	0.1	0.4	0.1	0.3	0.1	0.2	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.3	0.0	0.2	0.1	0.1	0.0	0.1	0.1
21 Household electrical machinery	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22 Communication electronics equipment	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.3	0.0	0.1	0.0
23 Electronic computing equipment	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
24 Electronic parts	0.1	1.5	0.4	1.3	0.6	4.0	6.6	3.8	0.0	0.0	0.1	0.0	2.1	0.1	1.2	0.5	1.4	0.9	2.5	2.9	2.7	0.0	0.0	0.1	0.0	1.3
25 Passenger cars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26 Other motor vehicles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27 Auto parts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.9	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	1.8	0.2	0.0
28 Other transport equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
29 Precision machinery	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
30 Other manufacturing products	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.0
Total intermediate inputs	2.5	4.6	2.9	4.6	1.9	8.0	12.1	7.4	2.7	2.9	2.5	1.7	5.7	2.5	3.5	2.9	3.1	2.4	4.1	4.1	4.2	3.7	3.5	3.4	1.9	2.9
Total production	4.0	5.7	4.3	6.7	2.4	11.0	17.1	10.3	3.0	2.9	3.1	2.3	9.5	2.5	3.5	2.9	3.2	2.4	4.1	4.1	4.2	3.7	3.5	3.4	2.0	2.9

Notes: machinery sectors are from the sector 17 to the sector 29. Non-manufacturing sectors are excluded on the input side, and only machinery sectors on the output side are shown.

Data: author's calculation, based on the regional input-output table in 2005 (the version with 53 sectors).

When we focus only on the production in the Kanto region, the share of input from the Tohoku region exceeds 4 % in total in sectors of the communication electronics equipment, electronic computing equipment, and electronic parts. In particular, electronic parts and auto parts that are produced in the Tohoku region seem to form an important part of production; the share of input of auto parts from the Tohoku region is larger for the production in the Kanto region than the average (the whole Japan). All of these analyses suggest that non-disaster areas, particularly the Kanto region, are tightly connected with disaster areas in domestic production networks, and thus they had negative impacts on production activities particularly in the machinery sector through supply chains.

Insufficient supply of intermediate goods from the disaster areas had direct negative effects on production in non-disaster areas, particularly just after the EJE from March to June. What was more serious for production activities from July to September in Japan was the implementation of an electricity saving policy (compulsory regulation on the usage of electric power to save electricity). Although firms made great efforts to cope with this regulation and took various actions, this regulation apparently resulted in the reduction of production.[xii]

The 2011 Thailand floods, which occurred in October 2011, also had negative impacts on production networks and Japanese firms, because many Japanese firms have operations in the disaster areas and play important roles in supply chains. The JETRO conducted an interesting survey on the firms suffering from the floods in Thailand. Table 6 presents the situation of the damage of Japanese firms in Thailand (multiple answers were allowed). Some firms were directly affected, while others were indirectly affected. 41 % of the manufacturing firms in the sample (81 firms) had indirect negative impacts; 16 % was due to the damage of the firm to which a firm in the survey sells its products, 22 % was due to the damage of the firm from which the corresponding firm purchases products, and 16 % are due to the damage of some firms in a line of supply chains. These figures confirm that many firms were indirectly affected even if they did not have direct damage from the floods. It implies that when production networks exist, negative impacts are likely to expand through supply chains.

Table 6: Damage of Japanese Firms in Thailand from the 2011 Thailand Floods

	Manufacturing		Non-manufacturing	
	Number of firms	Share	Number of firms	Share
Directly damaged	**40**	**49.4%**	**8**	**16.7%**
Inside of industrial estates	36	44.4%	6	12.5%
Outside of industrial estates	4	4.9%	4	8.3%
Indirectly damaged	**33**	**40.7%**	**11**	**22.9%**
Damage by firms to supply	13	16.0%	5	10.4%
Damage by firms to purchase	18	22.2%	2	4.2%
Damage by a part of supply chains	13	16.0%	4	8.3%
Not damaged	**8**	**9.9%**	**29**	**60.4%**
The number of effective answers (firms)	81		48	

Notes: multiple answers are allowed. The rate of effective answers in total is 69.3%.
Data: JETRO (2012).

On the other hand, the existence of the production networks seems to conferrobustness. Among firms that directly suffered from the floods, more than half of the firms in the sample (40 %) were planning to maintain the size of operations before the crisis, which is higher than the share for non-manufacturing firms (38 %) (Table 7). Moreover, more than three-quarters of the firms in the sample were planning to maintain operations at the same locations, and 15 % of the firms at different locations in Thailand, rather than going other countries (multiple answers wereallowed). Even those who were going to move some production blocks to other countries as a risk-diversificationmeasure were also intending to keep some production sites in Thailand.

Table 7: The Expected Size of Operations and Locations for Firms Directly Damanged

(a) The expected size of operations

	Manufacturing		Non-manufacturing	
Steady	21	52.5%	3	37.5%
Shrinkage	16	40.0%	3	37.5%
Expansion	0	0.0%	0	0.0%
Not decided yet	3	7.5%	2	25.0%
The number of effective answers (firms)	40		8	

(b) The expected location of operations

	Manufacturing		Non-manufacturing	
Same place	31	77.5%	7	87.5%
Other place in Thailand	6	15.0%	2	25.0%
Relocation to other countries	3	7.5%	0	0.0%
Exit	0	0.0%	0	0.0%
Not decided yet	3	7.5%	0	0.0%
The number of effective answers (firms)	40		8	

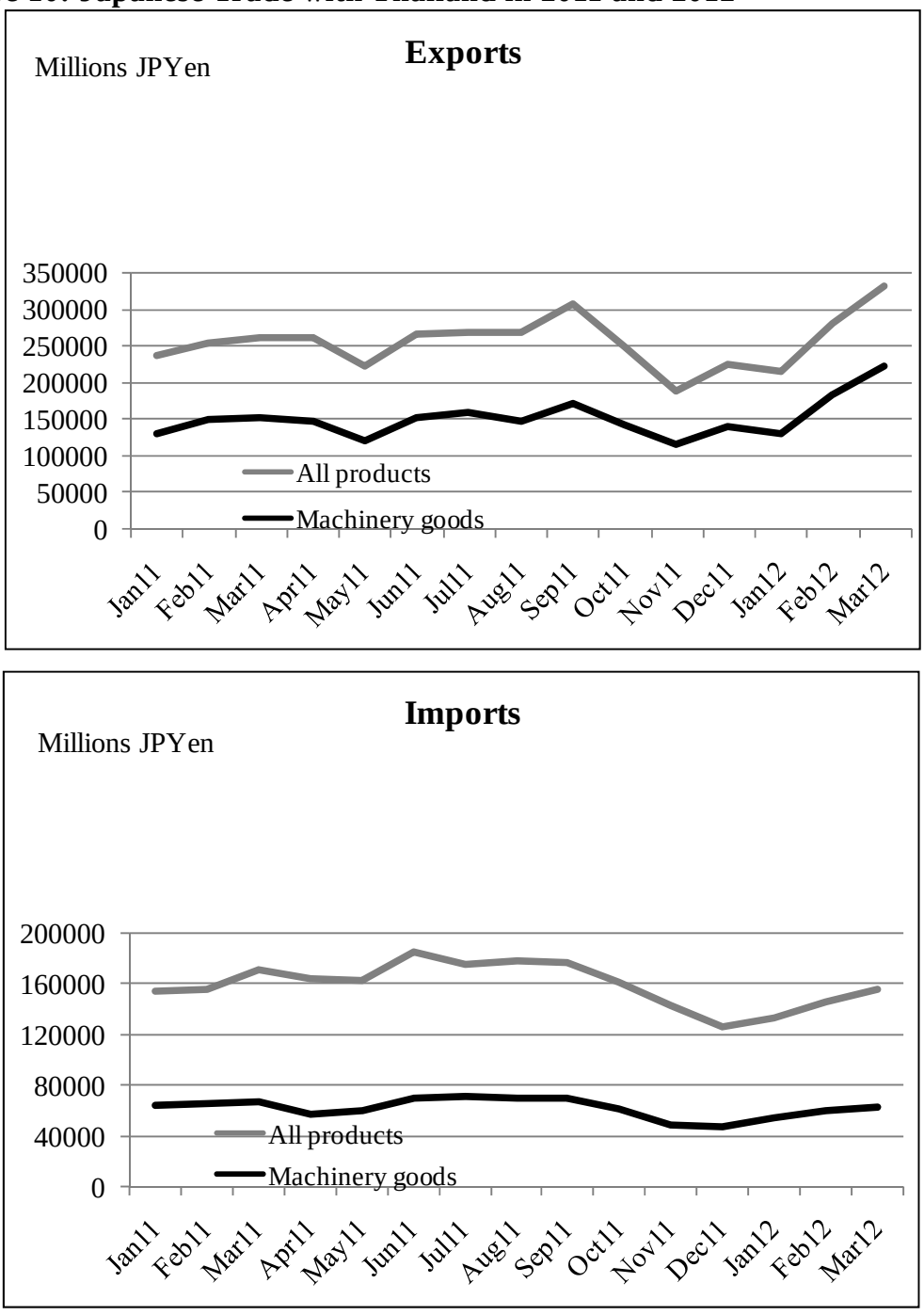
Note: multiple answers are allowed for (a).
Data: JETRO (2012).

The major reason why firms were intending to stay in the same places or at least to stay in Thailand was that most of them were already involved in supply chains in Thailand, and thus the movement of production blocks abroad would require a change in transactions, i.e., the origins of purchases and the destinations of sales, which would lead to large transaction costs. In practice, other countries also have risks, such as political risks and natural disasters, while Thailand has advantages in infrastructure and industrial clustering. Thus, with a consideration of these elements, firms tended to choose to stay in the same places, or to move only todifferent places in Thailand.

Actually, those firms that suffered seriously from the 2011 Thailand floods are making great efforts to restore operations as quickly as possible. As Figure 10 shows, Japan's exports to and imports from Thailand declined in October and November 2011. In order to replace capital goods and other machinery damaged by the floods, however, Japan's exports to Thailand are drastically increasing in 2012. In other words, involvement in production networks and the existence of

industrial clustering generate strong incentives to maintain the networks in order to avoid transactions costs, even if the networks tend to spread negative shocks, at least temporarily, when they encounter supply or demand shocks.

Figure 10: Japanese Trade with Thailand in 2011 and 2012



Data: author's preparation, based on the data available from the Ministy of Finance.

Source: Ando and Kimura (2005) (adjusted to the HS2007 classification).

7. Conclusion

This paper has focused on domestic/international production networks in machinery industries, and has examined how the economic crisis and natural/technological disaster that Japan encountered in recent years affected the networks and trade, mainly from the viewpoint of Japan's exports.Regardless of whether creating demand shock or supply shock, the economic/natural disasters revealed the stability and robustness of production networks in machinery sectors. It is true that the shocks seriously damaged production networks, and their negative impacts were transmitted through production networks, at theiroutset. Strong forces, however, worked to keep production networks in being, and quick adjustments for recovery were implemented. As the extended fragmentation theory states, the fragmentation of production takes advantage of the reduction in production cost within production blocks, while it should pay for the network set-up/adjustment cost and the service link cost.[xiii] The latter two costs are particularly high for transactions in parts and components compared with transactions in final products. In order to respond to massive shocks, firms try to save these costs by keeping existing transaction channels for parts and components. As a result, exports in machinery parts and components tend to be sustained, and are likely to recover rapidly even if they are temporarily discontinued. Even the behavior of firms involved in the production networks and suffering from the Thailand floods also confirms the existence of strong continuation forces and the deployment of efforts to keep production networks in being, in consideration of the various transaction cost implications of discontinuing a network.

Conversely, once production networks are moved away from Japan, it is not easy to get them back. Therefore, it is quite important to deal with various concerns in the business environment. Indeed, in the case of the EJE, there still remains the risk of "hollowing-out (kudo-ka)" due to continuing the shortage of electricity supply and substantial JP Yen appreciation. The same discussion can be applied to countries involved in the production networks, such as Thailand. To rebuild infrastructure and implement policies that help restart operations, such

as tax-exemptions for imports of capital goods or what needs to make factories restart operations as quickly as possible, is important. So far, Thailand hasrelatively great advantages, particularly due to a better business environment in terms of infrastructure and industrial clustering, compared with that in surrounding countries, but it is important to recover the better business environment as soon as possible and further improve it. Otherwise, private firms may utilize the crisis as a trigger for removing production blocks to other countries.

The 2011 EJE and its aftermath as a technological disaster also remind us of the importance of reliable safety guarantees and of nurturing international credibility on export products such as agriculture and food products.

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APPENDIX

Table A.1 The Definition of Machinery Parts and Components

8406, 8407, 8408, 8409, 8410, 8411, 8412, 8413, 8414, 8416, 8417, 8431, 8448, 8466, 8473, 8480, 8481, 8482, 8483, 8484, 8486, 8487, 8503, 8505, 8507, 8511. 8512, 8522, 8529, 8531, 8532, 8533, 8534, 8535, 8536, 8537, 8538, 8539, 8540, 8541, 8542, 8544, 8545, 8546, 8547, 8548, 8607, 8706, 8707, 8708, 8714, 8803, 8805, 9001, 9002, 9003, 9013, 9014, 9033, 9104, 9110, 9111, 9112, 9113, 9114, 9209, 840140, 840290, 840390, 840490, 841520, 841590, 841891, 841899, 841990, 842091, 842099, 842123, 842129, 842131, 842191, 842199, 842290, 842390, 842490, 843290, 843390, 843490, 843590, 843691, 843699, 843790, 843890, 843991, 843999, 844090, 844190, 844240, 844250, 844391, 844399, 845090, 845190, 845240, 845290, 845390, 845490, 845590, 846791, 846792, 846799, 846890, 847490, 847590, 847690, 847790, 847890, 847990, 850490, 850690, 850870, 850990, 851090, 851390, 851490, 851590. 851690. 851770, 851840, 851850, 851890, 852352, 853090, 854390, 870990, 871690, 900590, 900691, 900699, 900791, 900792, 900890, 901090, 901190, 901290, 901590. 901790, 902490, 902590, 902690, 902790, 902890, 902990, 903090, 903190, 903290

Source: Ando and Kimura (2005) (adjusted to the HS2007 classification).

ENDNOTES

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[1] Sections 2 to 4 are based on some of the results in Ando and Kimura (2012).

[2] Machinery goods are composed of general machinery, electrical machinery, transport equipment, and precision machinery (Harmonized System (HS) 84-92). See Ando and Kimura (2012) for the definition of machinery parts and components. Machinery final products are defined as machinery goods other than machinery parts and components. Automobiles are final products only in HS87.

[3] East Asia in this chapter includes the following 14 countries/economies: Association of South-East Asian Nations (ASEAN) 10, China, Korea, Hong Kong, and Taiwan.

[4] East Asia itself also became a major contributor to the recovery of East Asian trade, not only for machinery parts and components but also for machinery finished products (Ando, 2010). Also see Haddad and Shepherd (2011) for an interesting series of analyses of trade and economies under the GFC.

[5] EU refers to the EU27 in this chapter.

[6] The number of exported product-country pairs is expressed as an index based on the number in January 2007; the corresponding number for all products exported to the world is 66,119.

[7] The decomposition of changes in trade into extensive and intensive margins may change when data at a different level of disaggregation are used. For instance, the results based on data at the most disaggregated level (HS 9-digit level in the case of Japan) may be more likely to make the extensive margins appear larger than the results based on data at more aggregated levels such as the HS 6-digit level. Also, if we use some cutoff point to identify the extensive margins, the results may change. However, the major findings discussed here do not change even if we use different levels of aggregation.

[8] See Ando and Kimura (2012) for the features of exports to the US and EU.

[9] Some countries in the Middle East imposed import prohibition on any agriculture and food products produced in Japan, regardless of where they were produced in Japan. Such strict trade restrictions should

directly influence the number of exported products.

[10] Indices of industrial production and regional input-output tables are available from the following websites, respectively;
http://www.meti.go.jp/english/statistics/tyo/iip/index.html, and
http://www.meti.go.jp/statistics/tyo/tiikiio/result/result_02.html.

[11] The disaster areas in this figure are the designated regions to which the Disaster Relief Act (Saigai Kyujo Hou) may apply.

[xii] See METI (2012) for the detailed analysis of industrial activities in F/Y2011.

[xiii] See Ando, *et al.* (2009) for the two-dimensional fragmentation and their costs in terms of fixed costs, services link costs, and production cost per se.

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