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Development and Restructuring of Regional Production/Distribution Networks in East Asia

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Abstract: *This paper attempts to investigate the features of development and restructuring patterns of production/distribution networks in East Asia, mainly in machinery sectors, using international trade data at the most disaggregated level, to discuss their resilient nature, and to provide policy implications for the regional production networks and the economic development in the region. Although the negative impacts of the Global Financial Crisis (GFC) in 2008 were initially transmitted through the networks, the production/distribution networks in East Asia rather revealed their resilient nature. Our empirical analysis demonstrates that intra-regional machinery trade has been enhanced and contributed as a source of quick recovery from the GFC, and that the restructuring of regional production/distribution networks has been accelerated with the GFC as a trigger. Our study on trade patterns in terms of extensive margins also demonstrates clearly how the extent and depth of regional production networks have been changing, particularly after the GFC. Based on our empirical investigation, we discuss challenges and policy implication for the further development of the production networks and economic development and integration in the region.*

Keywords: The extent and depth of regional production networks, East Asia, Extensive margins, Regional integration

JEL classification: F14, F23

1. Introduction

The formation of international production/distribution networks in East Asia, with extensive promotion of foreign direct investment (FDI), has enhanced regional manufacturing competitiveness and contributed to the rapid economic growth of countries in the region.[1] The competitive industrial performance (CIP) index, which is compiled by the United Nations Industrial Development Organization (UNIDO), and measures the ability of countries to competitively produce and export manufactured goods, clearly indicates that East Asian countries have strengthened their manufacturing competitiveness, and their indices are higher than the sample average in most cases. In particular, China and Vietnam have rapidly improved their competitiveness in recent years, and four out of 11 East Asian countries are ranked in the top 10 of the 118 countries in the index.

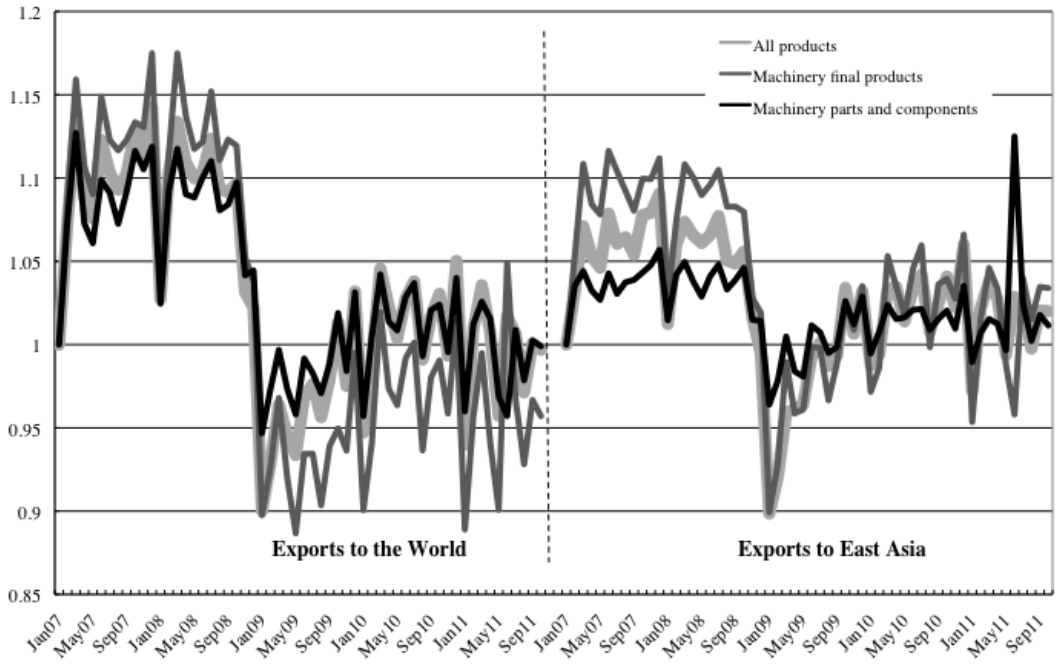
Table 1: Competitive Industrial Performance (CIP) Index and its Ranking for East Asia

	Rank					Index				
Country	1985	1993	1998	2003	2009	1985	1993	1998	2003	2009
China	61	28	30	27	5	0.02	0.34	0.38	0.41	0.56
Hong Kong	18	6	9	13	17	0.32	0.58	0.58	0.53	0.38
Indonesia	65	60	54	47	43	0.01	0.22	0.25	0.26	0.20
Japan	2	3	4	4	3	0.73	0.74	0.72	0.72	0.63
Korea	22	17	15	9	7	0.25	0.48	0.51	0.59	0.48
Malaysia	30	20	17	19	27	0.12	0.46	0.49	0.47	0.32
Philippines	45	44	28	32	33	0.04	0.27	0.39	0.40	0.27
Singapore	6	1	1	1	1	0.59	0.84	0.89	0.90	0.64
Taiwan	19	10	12	10	11	0.29	0.51	0.55	0.54	0.44
Thailand	43	32	29	28	25	0.06	0.32	0.39	0.41	0.32
Viet Nam	...	...	99	72	58	...	...	0.11	0.19	0.17
# of samples/ sample average		100	118	120	118		0.28	0.28	0.28	0.21

Note: Indices higher than the sample average are highlighted.
Source: UNIDO database.

The Global Financial Crisis (GFC) in 2008 had huge and prolonged impacts on the world economy, including the East Asian market and the regional production/distribution networks mainly in machinery sectors. For instance, Japanese real exports did decline significantly, but recovered rapidly from the GFC. Such a recovery of export values, however, does not necessarily imply that trading patterns simply returned to the ones before the GFC. There seems to have been a permanent change in the extensive margins of Japanese exports; the number of exported product-country pairs at the HS 9-digit level dropped significantly and has not returned to the level of 2007 or 2008, though the number has shown a tendency to increase since January 2009 (Figure 1).[2] This suggests that the geographical distribution of their activities by Japanese firms, including those in East Asia, has been reshuffled, and that the basis of Japanese exports has been narrowed, with the GFC as a trigger.

Figure 1: The number of Japanese Exported Product-Country pairs, Indexed to January 2007



Source: Ando and Kimura (2012).

This paper attempts to investigate the features of development and restructuring patterns of regional production/distribution networks, mainly in machinery sectors, using international trade data at the most disaggregated level that is internationally

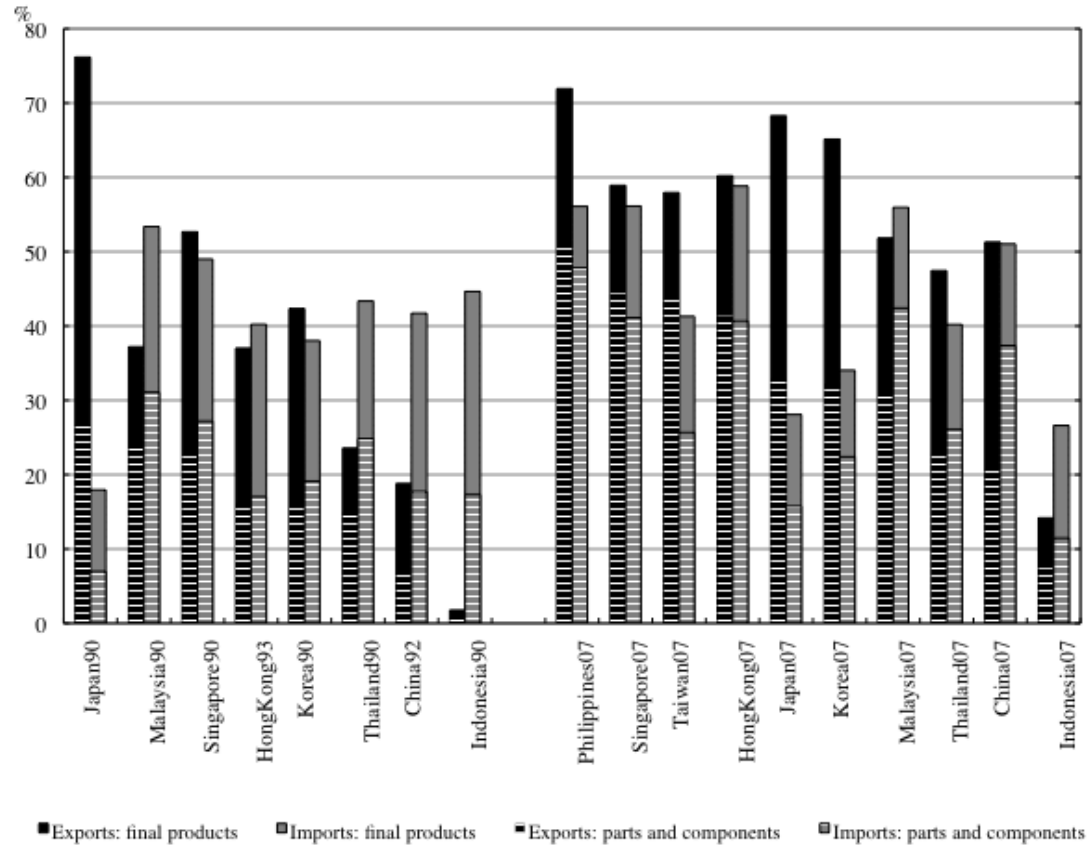
comparable, i.e., HS 6-digit level. At the same time, the paper discusses the behavior of production networks when faced with demand/supply shocks, their resiliency and their contribution as a source of quick recovery.

The rest of the paper is organized as follows; the next section briefly introduces the features of the development of regional production/distribution networks since the 1990s. Section 3 examines patterns of trade for East Asian countries after the GFC, in terms of extensive margins to investigate the extent and depth of regional production/distribution networks, and to demonstrate how the networks are being restructured. Section 4 discusses the nature of regional production/networks when faced with demand/supply shocks, and section 5 discusses challenges and policy implications.

2. The Development of Regional Production/Distribution Networks

Machinery trade comprises a significant proportion of trade with the world for each East Asian economy, and the shares of machinery trade, in particular machinery parts and components trade, rapidly increased from the early 1990s to 2007 (Figure 2).[3] In addition, the ratios of machinery intermediate goods are high for both exports and imports in East Asia. This evidence indicates the existence of export-oriented operations, as well as an active and drastically expanding vertical back-and-forth transactions, reflecting the development of fragmentation of production.[4]

Figure 2: Machinery Trade in East Asia: Share in Total Exports/Imports (early 1990s and 2007).



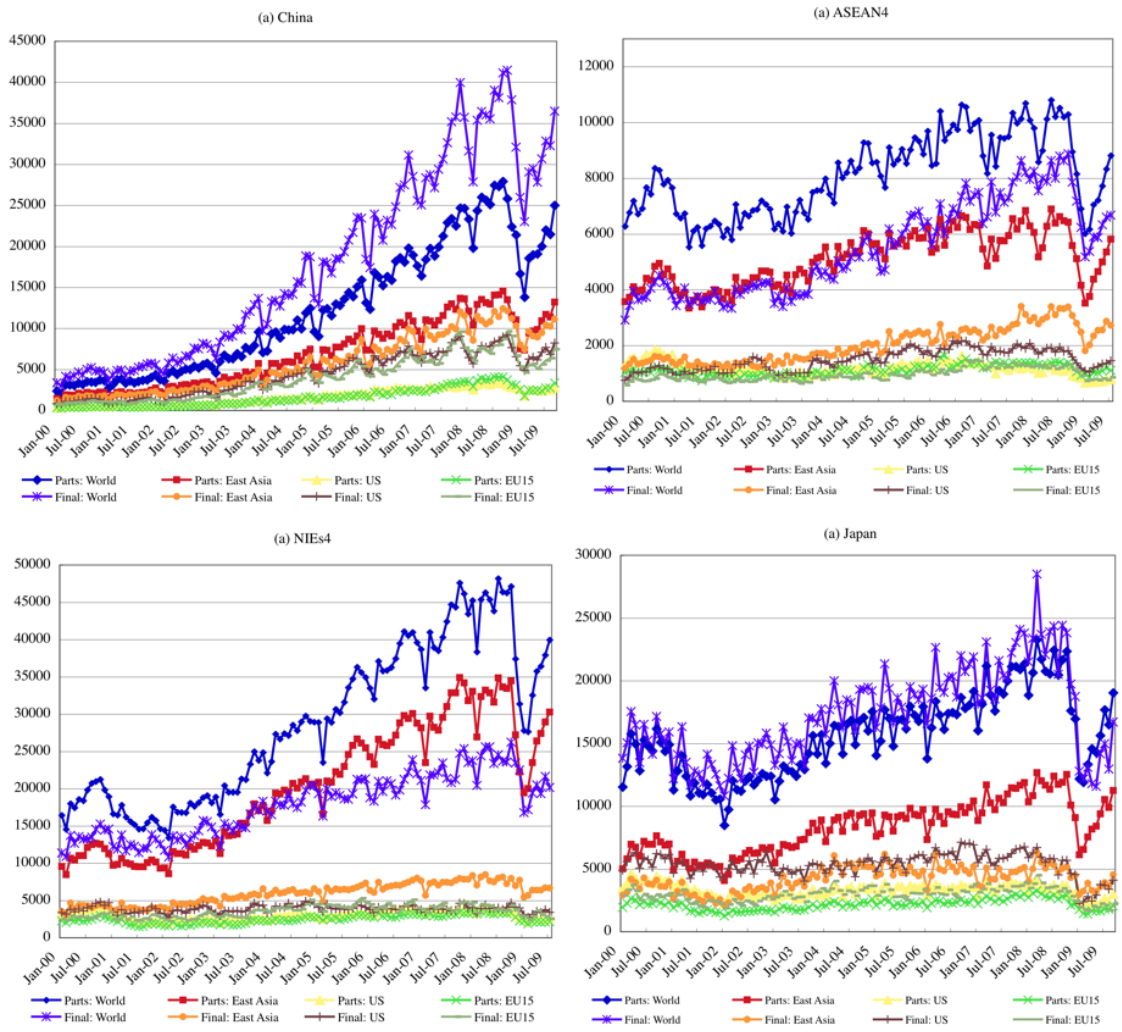
Source: Ando (2010).

The proportions of machinery trade, in particular the machinery parts and components trade, have also tended to grow for countries in other regions. While most countries with higher shares of machinery parts and components exports were developed countries in the early 1990s, however, they were replaced by East Asian countries in 2007, with much higher shares. In other words, the significance of machinery trade, mainly machinery intermediate goods trade, has shown a definite relative increase for each economy in East Asia.

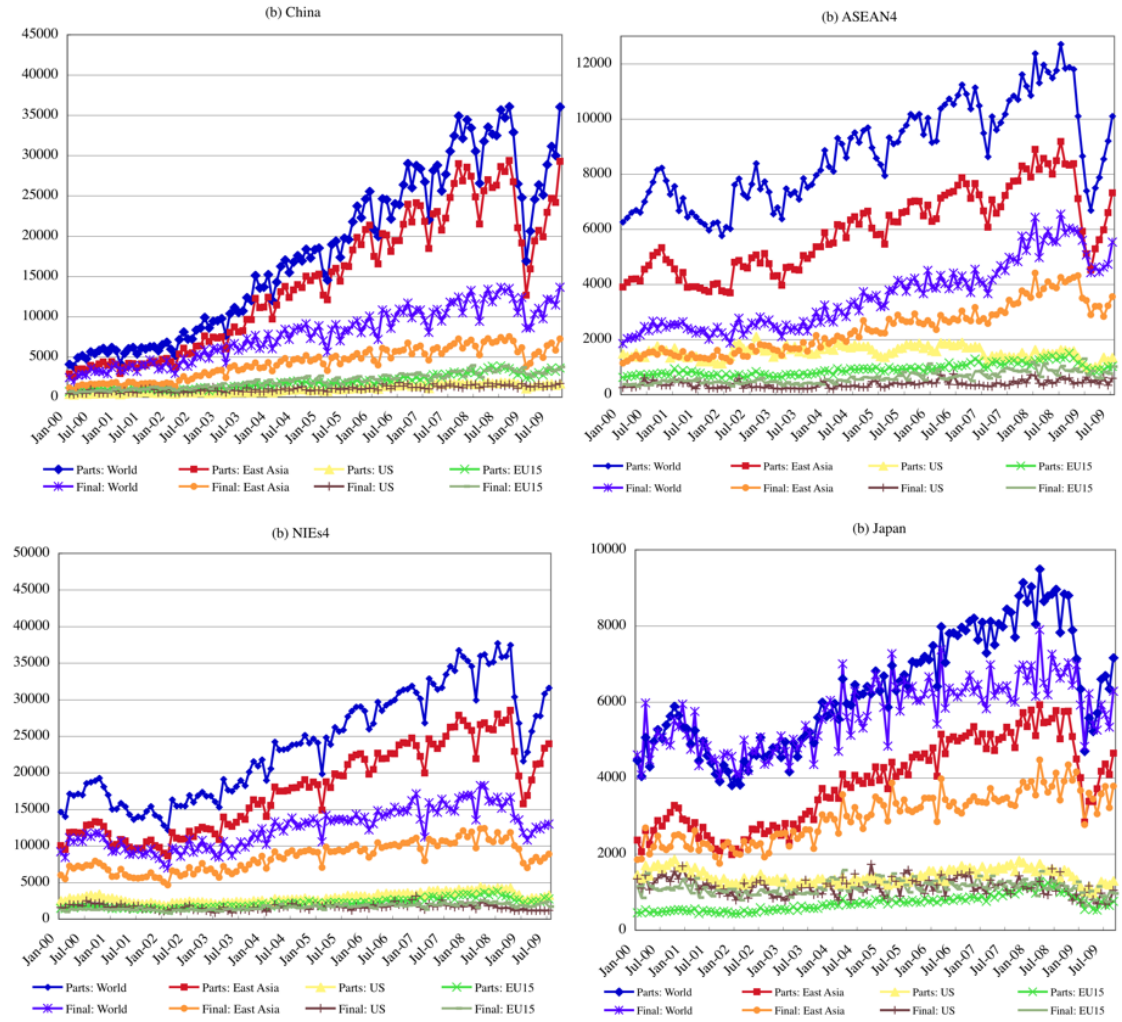
A large proportion of the above-mentioned machinery parts and components trade in East Asia is intra-regional. Moreover, intra-regional trade values of machinery parts and components *per se* have significantly expanded, indicating how explosively and rapidly vertical back-and-forth

transactions in machinery parts and components had proliferated throughout the region in the 2000s, until the GFC occurred (Figure 3).[5] [6]

Figure 3: Monthly Machinery Trade since 2000 for East Asia
(a) exports (millions US$)



(b) Imports (millions US$)



Source: Ando (2010)

3. Restructuring Regional Production/distribution Networks after the Global Financial Crisis

Figure 3 also clearly shows that machinery trade rapidly bounced back from the significant fall caused by the GFC. In other words, there were indeed initial negative impacts from the GFC on regional production/distribution networks but, at the same time, East Asia's trade has rapidly recovered through the networks. In particular, East Asia itself is the major contributor to such a rapid recovery, in both machinery parts and components and machinery final goods trade (Ando, 2010). As

a result, intra-regional trade, particularly intra-regional machinery trade, fell below the 2007 level by only a few percent, despite the huge demand shock experienced throughout the world, at least on a nominal basis at the annual level (Table 2).[7] This finding suggests that regional production/distribution networks possess a resiliency against shocks.

Table 2 also demonstrates important further evidence that the East Asian market is rising in its significance as a market for final products. In a short period from 2007 to 2011, the intra-regional export ratio rose from 30 percent to 36 percent. This rise in the share of intra-regional exports in all exports is not only due to the demand decline in the US and EU but also to an expansion of intra-regional exports in machinery final products *per se*; their export to the world in 2011 was 1.3 times that in 2007, their intra-regional exports was up 1.5 times. Even on the import side, the intra-regional share for machinery final products were close to 60 percent, and the intra-regional value expanded by 51 percent. The inter-regional markets such as those in the U.S. and the EU, are still important, but East Asia is increasingly gaining importance not only as a production site but also as a consumption site for final products that are produced in the regional production/distribution networks.

Table 2: Intra-regional Trade of the East Asia 9: Value and Share

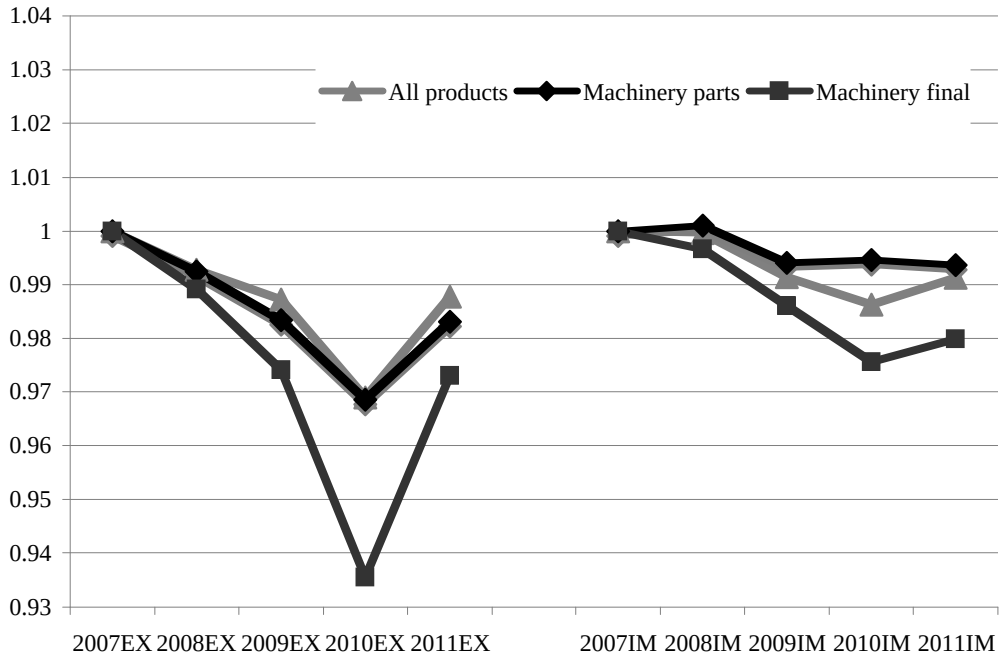
	Exports					Imports				
Destination/origin	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
(a) All products										
Value (nominal): 2007=1										
World	1.00	1.13	0.93	1.21	1.35	1.00	1.03	0.83	1.10	1.35
EastAsia15	1.00	1.12	0.95	1.26	1.40	1.00	1.12	0.93	1.23	1.42
Share: World=100										
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EastAsia15	48.1	47.6	49.1	50.0	50.1	53.4	50.2	51.5	51.6	48.7
China	12.6	12.3	13.6	13.9	13.9	14.8	13.9	14.5	13.8	13.2
CLMV	1.5	1.7	1.9	2.0	2.2	0.8	0.9	1.0	0.9	1.1
ASEAN4	7.9	8.2	8.0	8.5	8.6	10.6	10.2	10.2	10.6	10.1
ASEAN5	9.1	9.6	9.5	10.0	10.3	11.3	10.9	11.0	11.3	11.0
ASEAN10	12.9	13.4	13.5	13.8	13.9	14.8	14.5	14.6	14.9	14.4
NIEs4	19.6	18.9	19.2	19.4	19.1	16.6	15.2	15.7	15.9	15.0
Japan	6.5	6.5	6.3	6.1	6.1	10.4	9.9	9.9	10.2	9.1
(b) Machinery parts and components										
Value (nominal): 2007=1										
World	1.00	1.06	0.94	1.19	1.31	1.00	1.05	0.91	1.19	1.27
EastAsia15	1.00	1.04	0.95	1.19	1.30	1.00	1.04	0.90	1.22	1.28
Share: World=100										
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EastAsia15	63.9	62.4	65.1	64.0	63.5	69.9	69.3	69.3	71.3	70.7
China	20.9	20.9	23.6	22.0	22.8	14.2	15.1	15.3	15.1	15.7
CLMV	0.7	0.9	1.1	1.1	1.3	0.3	0.4	0.4	0.5	0.6
ASEAN4	10.5	10.3	9.7	9.8	9.3	12.5	11.7	11.1	11.9	11.2
ASEAN5	11.1	11.1	10.6	10.8	10.5	12.8	12.1	11.5	12.4	11.8
ASEAN10	15.7	15.1	14.8	15.0	14.1	17.2	16.7	16.4	17.1	16.4
NIEs4	26.2	24.7	25.6	26.3	25.2	28.2	27.0	27.9	28.7	28.2
Japan	5.7	5.6	5.1	4.8	4.8	14.7	15.1	14.6	15.1	15.0
(c) Machinery final products										
Value (nominal): 2007=1										
World	1.00	1.11	0.91	1.16	1.29	1.00	1.11	0.99	1.28	1.54
EastAsia15	1.00	1.12	0.99	1.32	1.52	1.00	1.12	0.97	1.29	1.51
Share: World=100										
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EastAsia15	30.4	30.6	33.3	34.7	35.8	58.7	59.0	57.2	59.0	57.8
China	6.2	6.2	6.6	7.4	7.5	23.4	23.1	24.5	25.3	25.5
CLMV	0.9	1.1	1.3	1.3	1.5	0.3	1.3	0.5	0.5	0.7
ASEAN4	4.6	5.0	5.1	5.5	5.7	9.9	10.2	9.9	10.0	9.1
ASEAN5	5.2	5.8	6.1	6.4	6.7	10.2	10.6	10.4	10.5	9.7
ASEAN10	8.4	9.1	9.9	9.6	10.2	13.3	14.5	13.8	13.2	12.6
NIEs4	14.6	14.3	15.6	15.8	16.2	11.4	10.7	10.4	10.0	10.6
Japan	4.2	4.1	4.7	4.7	4.8	13.6	13.7	11.8	13.2	12.0

Source: Author's calculation, using trade data available from the UN Comtrade database.

Focusing on intra-regional trade in machinery goods implies a change in the composition of trading pairs within the region or the reshuffling of regional production networking. In the period from 2007 to 2011, China and the CLMV saw their shares increase from 20.9 percent to 22.8 percent and from 0.7 percent to 1.3 percent, respectively, while the intra-regional share remained around 64 percent and Japan lost the share from 5.7 percent to 4.8 percent for machinery parts and components. In addition, China and the CLMV increased their shares even for machinery final products, while the Japan' share slightly increased. Note that Viet Nam was the main contributor to the increasing share for the CLMV, as you can guess from the difference between the share for the ASEAN 4 and that for the ASEAN 5 (ASEAN4 plus Vietnam). These suggest the restructuring of production/distribution networks as well as a greater recent participation by the CLMV, particularly Vietnam, in the regional networks, though the degree of participation is still low.

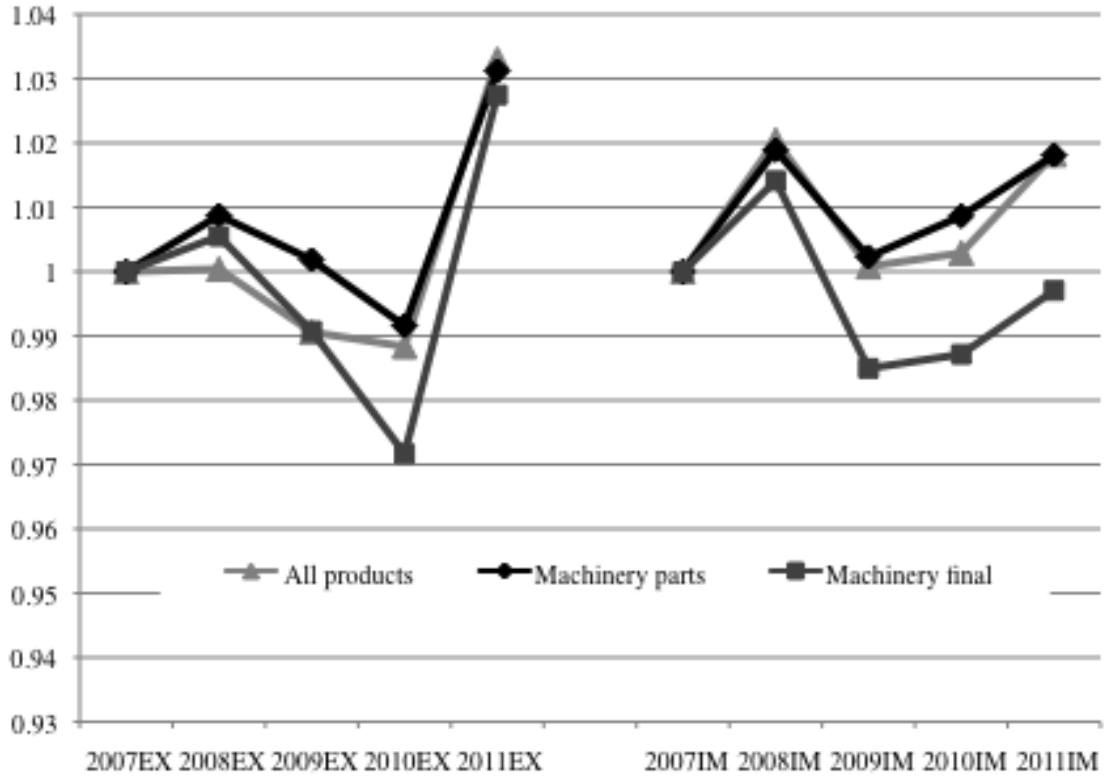
Figure 4 represents the number of products exported to/imported from the world, regardless of partner countries, for nine East Asian countries, and Figure 5 shows the number of exported/imported product-country pairs for intra-regional trade of the same countries.[8] [9] Interestingly, while the number of products exported to the world slightly declined after the GFC, the number of exported product-country pairs for intra-regional trade increased, particularly in 2011. The net increase in the sum of exported-country pairs among East Asian countries suggests that some countries began additional trade relationships with certain partners for certain products, and these new trade links exceeded the number of trade relationships ended by some countries.

Figure 4: The Number of Products Traded with the World by the East Asia 9 (2007=1)



Note: The number of products traded with the world is at HS 6 digit level, regardless of partner countries.
Source: Author's calculation, using data available from the UN Comtrade database.

Figure 5: The Number of Exported/imported Product-country pairs for Intra-regional Trade: East Asian 9 (2007=1).

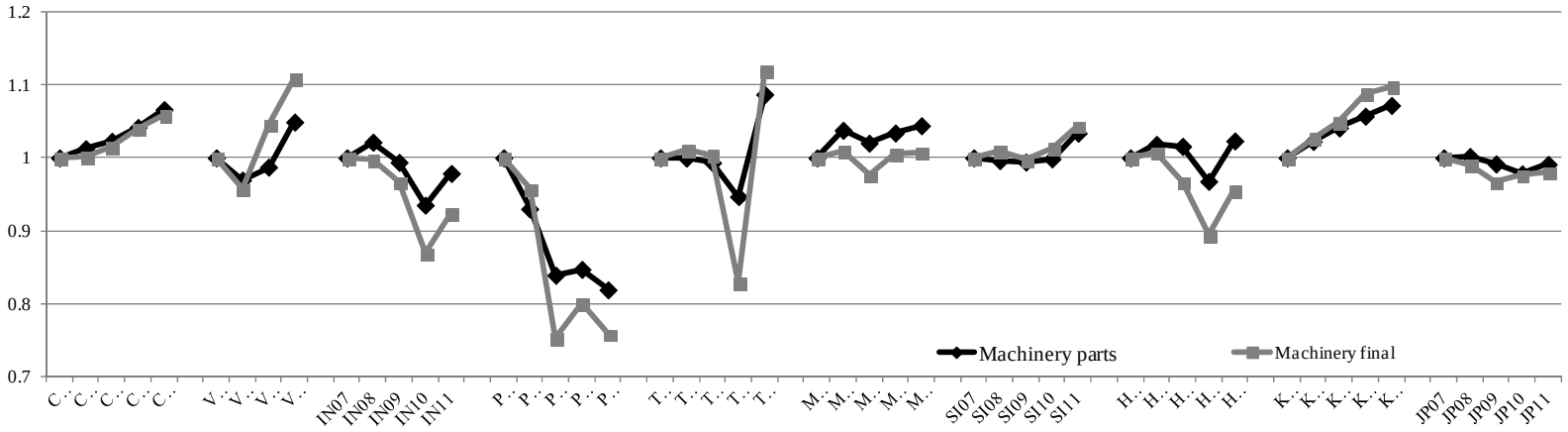


Note: Intra-regional trading partners are the East Asia 15.
Source: Author's calculations, using data available from the UN Comtrade database.

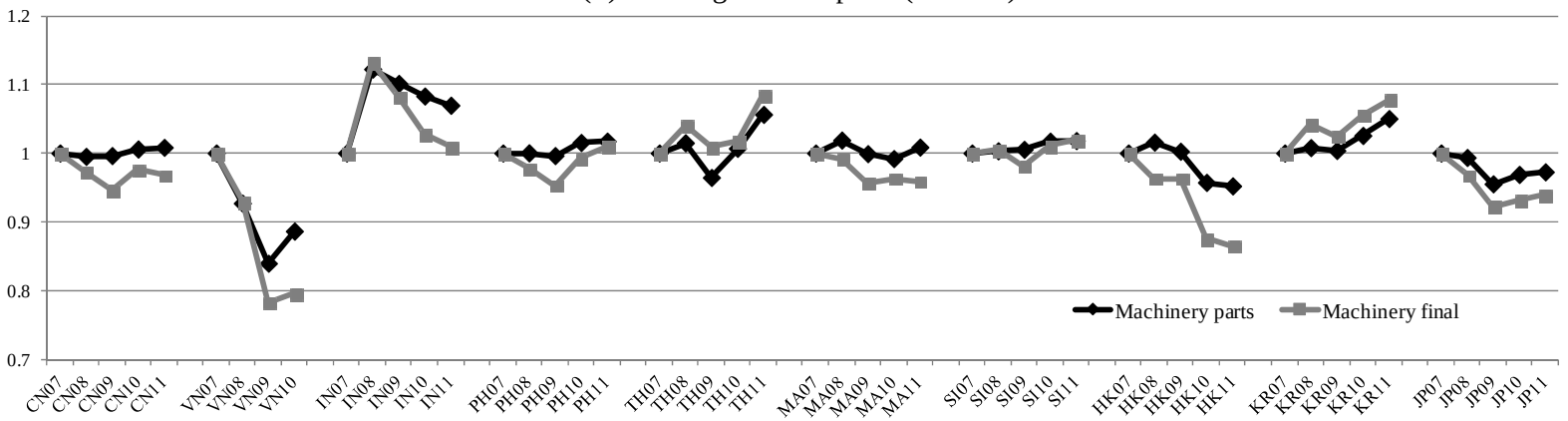
To investigate which countries entered the trading market and exited from it, we first examine changes in the number of exported/imported product-country pairs for each country's trade with the East Asia 15, focusing on machinery trade (Figure 6). China is steadily increased its export number in both machinery parts and components, and machinery final products. Korea also increased its number for both exports and imports in machinery parts and components as well as machinery final products, suggesting that Korea has become more active within the region. The number for Viet Nam is apparently increasing for exports, but has decreased for imports., This implies that Viet Nam began has begun to be connected to regional production networks, and has started new export relationships in place of imports. On the other hand, the Philippines has tended to reduce its number for machinery exports, suggesting that it may have been losing its position in the regional production networks in machinery sectors recently.

Figure 6: The Number of Product-Country Pairs for Intra-regional Machinery Trade

(i) Intra-regional exports (2007=1)



(ii) Intra-regioinal imports (2007=1)

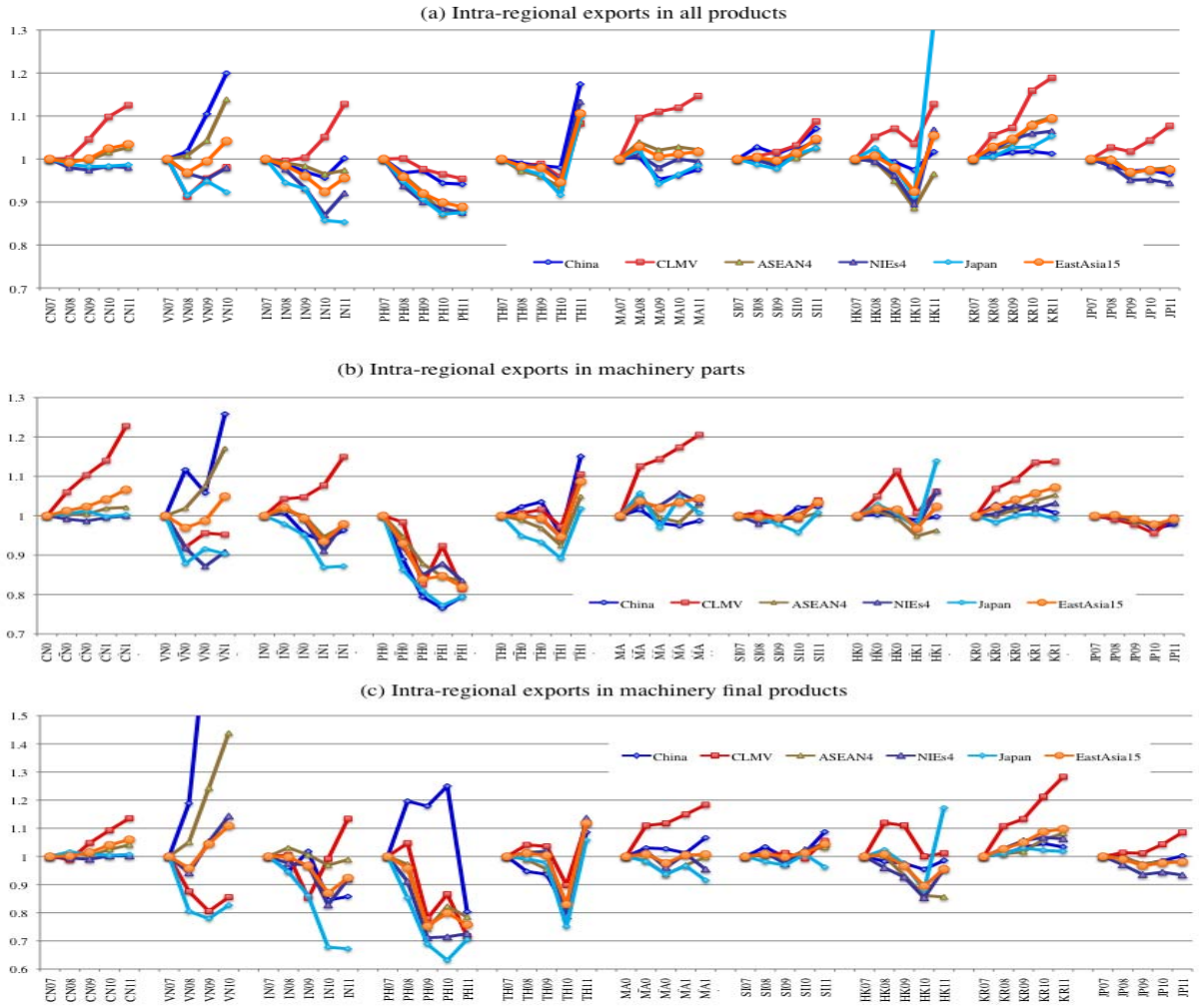


Source: Author's calculation, using data available from the UN Comtrade database

To further examine the restructuring patterns or the extent and depth of regional production networks in terms of extensive margins, we investigated the number of exported product-country pairs, by destination, for the intra-regional exports of each country; destinations are China, the CLMV, the ASEAN 4, the NIEs 4, Japan, and the East Asia 15 (Figure 7) [10]. Figure 8 shows the corresponding number of imported product-country pairs by origin for intra-regional imports. [11] These figures provide several interesting insights. First, the CLMV are rapidly becoming connected to both the machinery exports and imports of other East Asian countries. Of course, the number of products traded with the CLMV was quite small in 2007, compared with other economies/groups, and thus the index for the CLMV as a partner tends to fluctuate to a greater extent. Given this, however, the outstandingly rapid increase in the index for the CLMV implies that these countries, although mainly Viet Nam, are beginning to be connected to the regional production/distribution networks.

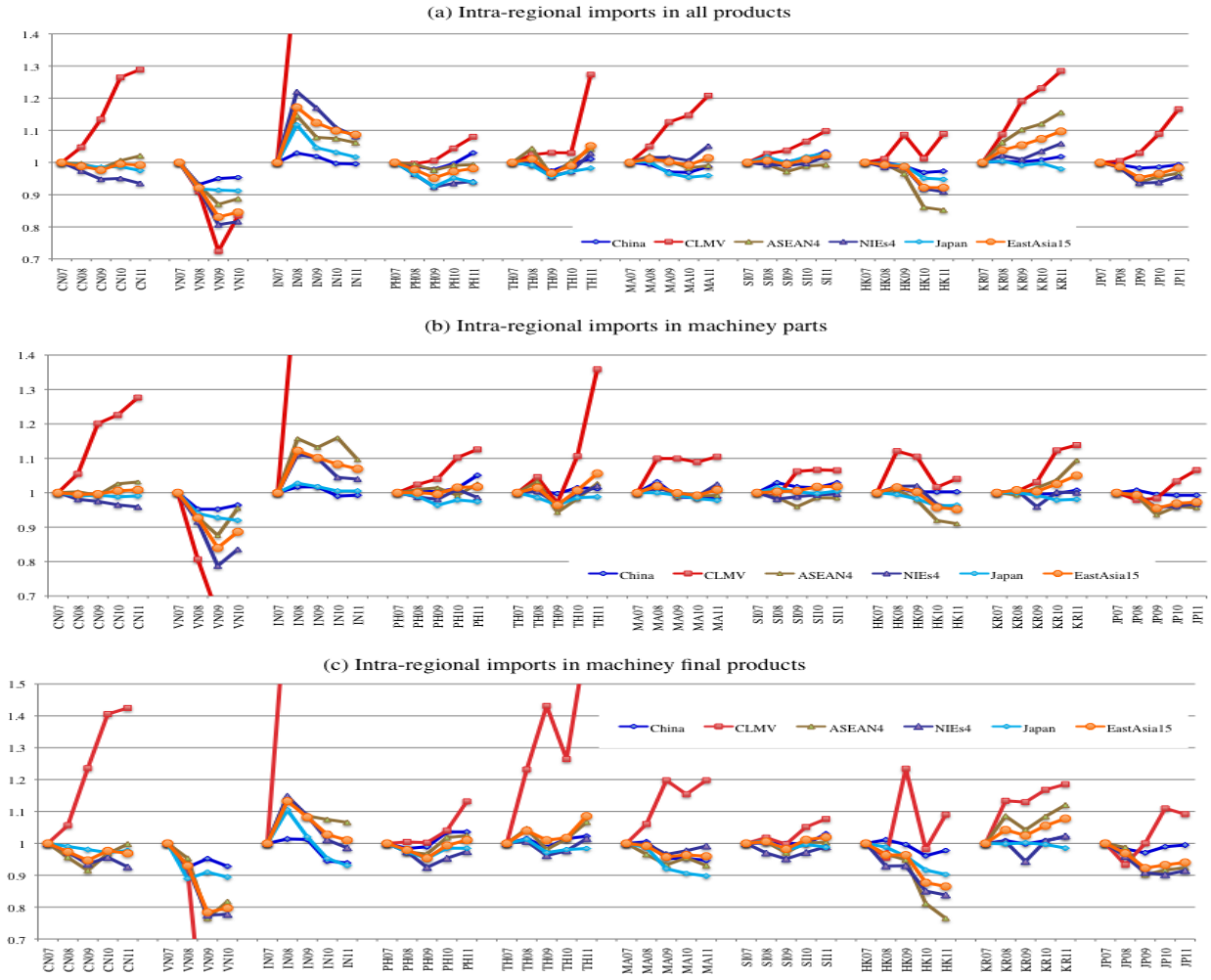
Secondly, China has increased the number of products traded with the ASEAN 4 and to the CLMV for both exports and imports in machinery parts and components. On the other hand, the number of machinery final products exported by China to the ASEAN 4 has increased, but the number imported from the ASEAN 4 has not. These statistics suggest that China is becoming a more important supplier of machinery final products, assembled from parts and components imported from other East Asian countries, particularly from the ASEAN countries.

Figure 7: The Number of Exported Product-Country Pairs by Destination (2007=1)



Source: Author's calculation, using data available from the UN Comtrade database.

Figure 8: The Number of Imported Product-Country Pairs by Origin (2007=1)



Source: Author's calculation, using data available from UNcomtrade.

Thirdly, connections between Viet Nam and China and between Viet Nam and the ASEAN 4 have been strengthening. The index for Viet Nam's exports to China/ASEAN 4 and the index for China's/ASEAN4's imports from the CLMV are increasing, both in machinery parts and components and final products, indicating that some transactions between Viet Nam and China and between Viet Nam and the ASEAN 4 have been started in recent years.

All of the discussion based on extensive margins and trade values/shares suggests that intra-regional trade has been enhanced, that it has contributed as a boost to recovery from the GFC, and that the restructuring of regional production/distribution networks has been accelerated, with the GFC as a trigger.

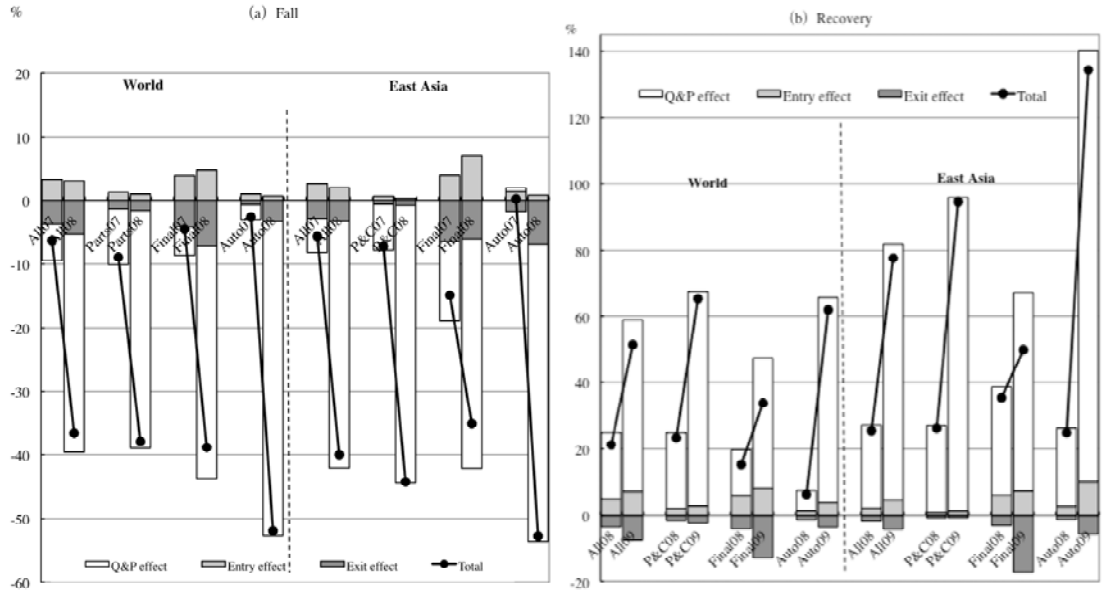
4. Resilient Nature of Regional Production/Distribution Networks

As discussed in the previous section, machinery trade rapidly recovered from the GFC and did not decline significantly in annual terns even during the GFC. This reflects the resilient nature of regional production networks. According to Obashi (2010a, 2010b), transactions within the production networks, particularly intra-regional trade in machinery parts and components, are stable, compared with other products, because the locations and firms involved in the networks are severally selected, and relation specific transactions are conducted once they are built. In addition, Obashi (2011) demonstrates that the probability of machinery trade recovery for products that disappeared at the time of the Asian Financial Crisis is higher than that of non-machinery trade.

Furthermore, Ando and Kimura (2012) demonstrate the resilience of regional production/distribution networks from the perspective of Japanese exports in face with the GFC and the Great East Japan Earthquake (EJE) that occurred in March 2012, using decomposition approach, logit estimation, and survival analysis. They decompose the fall/recovery of machinery exports into extensive margins (the entry effect and the exit effect) and intensive margins (the quantity effect and the price effect) and demonstrate that the exit effect (export decline due to discontinued trade relationships) is much

smaller in absolute terms for machinery parts and components than for other products, particularly in the case of exports to East Asia (Figures 9 and 10).[12] This evidence suggests the robust trade relationships for machinery parts and components, in particular for exports to East Asia, regardless of whether they encounter a demand shock or a supply shock.

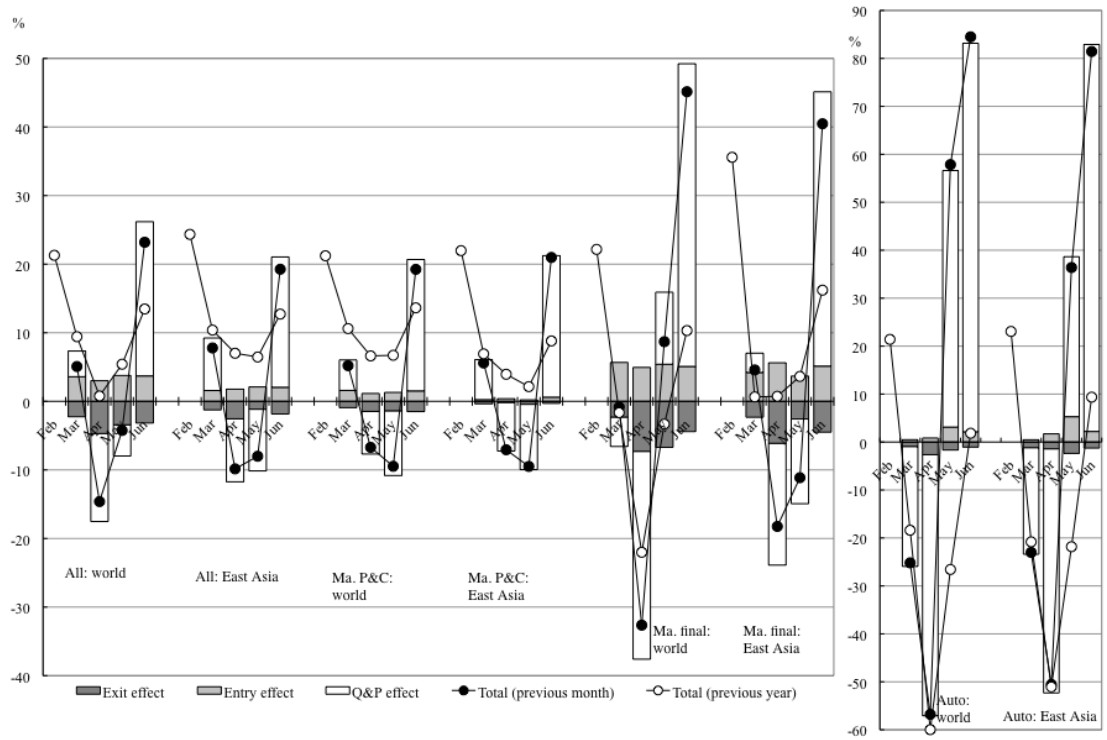
Figure 9: Decomposition of Changes in Japanese Real Exports under the 2008-2009 Crisis (US$)



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

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).

Figure 10: Decomposition of Changes in Japanese Real Exports under the 2011 EJE (US$)



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

They also analyze the probability of the fall and recovery of machinery exports resulting from the two crises, using logit estimation (and survival analysis).[13] The results indicate that machinery parts and components trade are less likely to be discontinued and are likely to recover even if trade ceases for a period (Table 3). The coefficient for parts and components is negative for the analysis of trade fall and positive for the analysis of trade recovery, with statistical significance. This suggests a robust trade relationship for machinery parts and components compared with machinery final products. The results also indicate that among East Asian countries, those that are heavily involved in the regional production networks tend to maintain trade relationships and are likely to recover trade even if they cease trade for a period. The coefficients for dummies of 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, Korea, Taiwan, and Thailand are large for both analyses, indicating the strong trade relationships in the production networks. In contrast, 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.

All findings confirm that regional production networks are robust even if negative impacts are initially transmitted through the networks. The fragmentation of production takes advantage of the reduction in production costs within production blocks, while the fragmentation should pay for the network set-up/adjustment cost and the service link cost. Firms try to place priority on keeping international production networks so as to minimize these costs by maintaining transaction channels for parts and components when they face demand/supply shocks.

Table 3: Probability of Trade Relationships of Japan's Machinery Exports under the Two Crises

	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) *
China	-1.74	(-18.85) ***	1.20	(7.70) ***	-2.11	(-20.4) ***	0.89	(4.81) ***
Thailand	-1.53	(-19.32) ***	1.11	(8.11) ***	-1.76	(-19.8) ***	0.79	(4.91) ***
Korea	-1.37	(-13.54) ***	1.38	(8.54) ***	-1.88	(-16.69) ***	0.96	(5.01) ***
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) ***
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) ***
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) ***
Viet Nam	-0.96	(-12.11) ***	1.38	(10.92) ***	-1.30	(-15.00) ***	0.87	(5.85) ***
Brunei	0.88	(4.17) ***	-0.75	(-2.38) **	1.02	(4.05) ***	-0.38	(-1.16)
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 observations	45979		20507		41827		16221	

Data: Ando and Kimura (2012).

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 percent level, ** at the 5 percent level, and * at the 10 percent level.

5. Challenges and Policy Implications

This paper investigated the features of development and restructuring patterns of production/distribution networks in East Asia, mainly in machinery sectors, and discussed their resilient nature. The development of production networks reflects the development of fragmentation of production, which involves fragmenting production processes that were originally located in one place into two or more production blocks (PBs) and locating them at appropriate places for each PB.

When PBs are fragmented, costs of service links (SLs) connecting PBs arise, while there can be a cost reduction at each PB utilizing from a location advantage. In particular, when PBs are located beyond the national border, SL costs include not only costs originating from geographical distance, such as transport costs, telecommunications costs, and coordination costs, but also costs across borders, typically trade barriers. Fragmentation thus occurs only when the SL costs are sufficiently low to make the total costs (i.e., production costs plus the SL costs) lower than otherwise.

To further utilize the mechanics of production networks, development strategies and industrial policies have to be considered as ERIA (2010) emphasizes in its "Comprehensive Asia Development Plan (CADP)". For instance, innovation in industrial agglomeration is necessary. Small and medium sized enterprises (SMEs) should play an important role in forming industrial agglomeration, and thus SME-related policies must be reviewed; better access to technology, better access to finance, fostering human resources, and establishing industrial organization may be helpful for their involvement in the industrial agglomeration and upgrading it.

It is also important to identify and resolve bottlenecks that prevent from deep participation into production networks in terms of three kinds of costs, namely network-set up cost, SL cost, and production cost. To reduce network-set up cost, policies such as investment liberalization, investment facilitation/promotion, intellectual property right (IPR) protection, and competition policies would be helpful. To reduce SL cost, policies to help the reduction of transactions costs in economic activities, including those mentioned above, tariff removal and trade facilitation, and enhancing institutional connectivity would be essential. To reduce production costs and strengthen location advantage, policies such as investment liberalization, upgrading infrastructure services such as electricity supply and creation of export processing zones (EPZs), enhancing agglomeration effects through SME development, and strengthening innovation would be beneficial.

In addition, connectivity needs to be considered, particularly to further deepen the regional production networks. East Asia is strongly connected to the outside economies, in addition to the countries in the region, through the production networks. For instance, Ando and Kimura (2013) analyzed the extent and depth of production networks in Europe from the perspective of their links with East Asia via Central and Eastern Europe (CEE) and demonstrated the strengthening competence for production networks in East Asia in machinery sectors, particularly in the electric machinery sector. Deepening regional integration and enhancing connectivity surely require open-oriented trade policies (rather than protectionism), various development strategies, and regional cooperation. While East Asia's integration has been market-driven, rather than rule-driven as is observed in Europe, free trade agreements (FTAs) must now be one of the tools for further trade and investment liberalization, and facilitation, and cooperation. This is a major challenge, and whether each economy in East Asia can implement the above-mentioned strategies and policies, depending on its stage of development and involvement in the production networks, will certainly influence whether regional production networks and regional integration/cooperation are successfully enhanced, and whether further economic development in the region is achieved.

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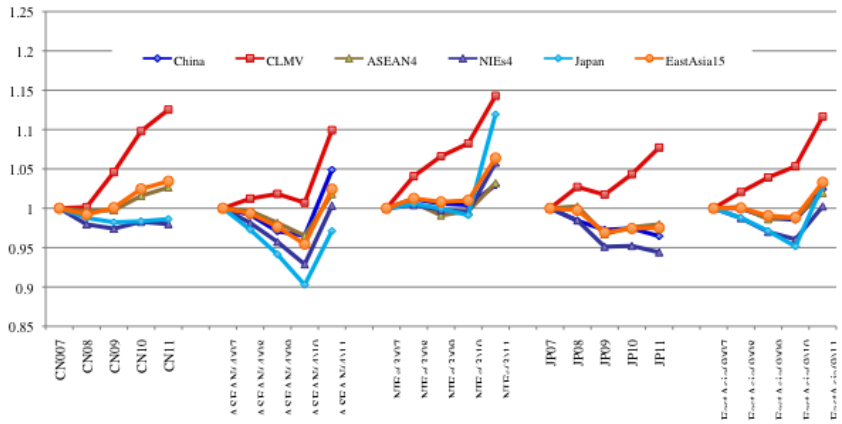
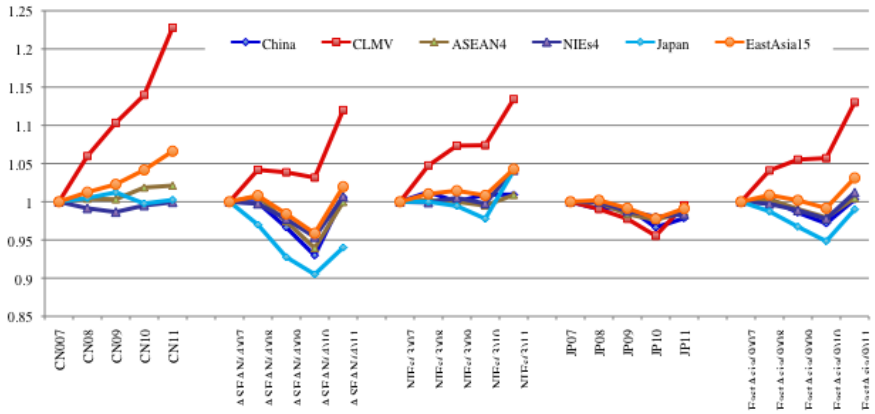
Figure A.1: The Number of Exported Product-Country Pairs by Destination (2007=1)

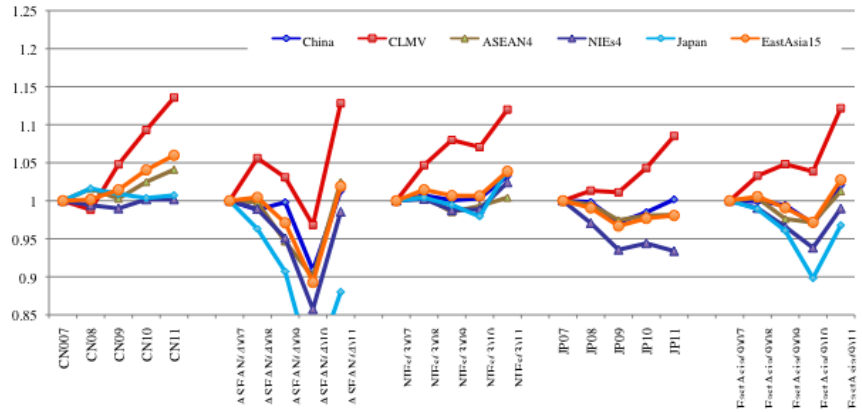
(a) Intra-regional exports in all products



(b) Intra-regional exports in machinery parts



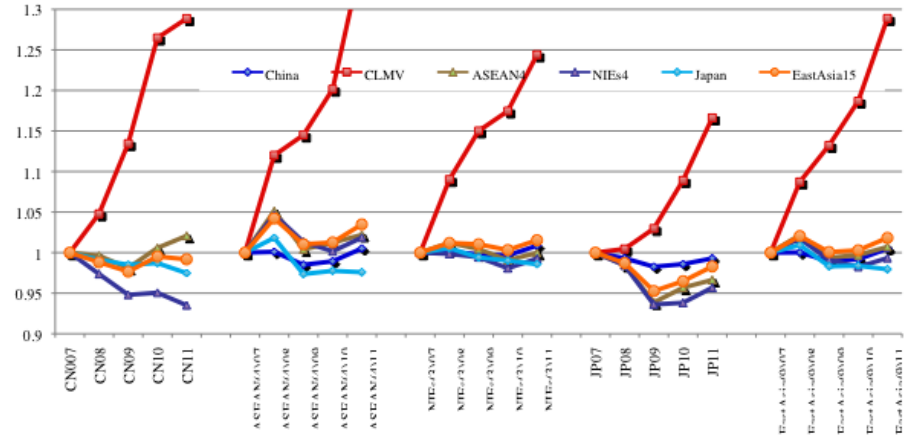
(c) Intra-regional exports in machinery final products



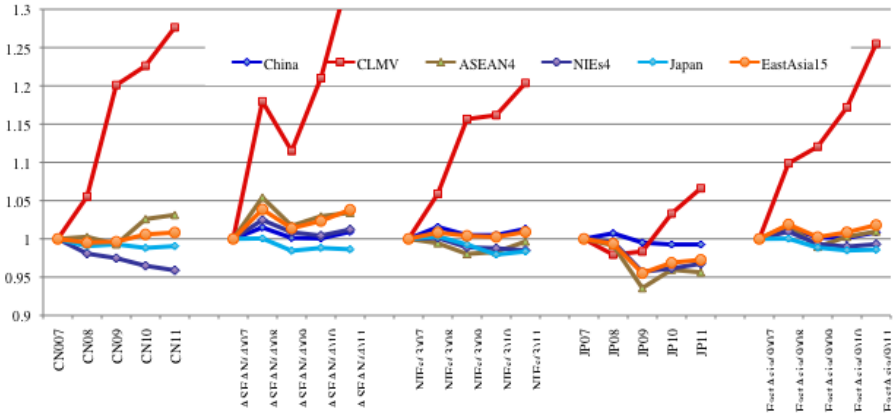
Source: author's calculation, based on data available from UN comtrade.

Figure A.2.: The Number of Imported Product-Country Pairs by Origin (2007=1)

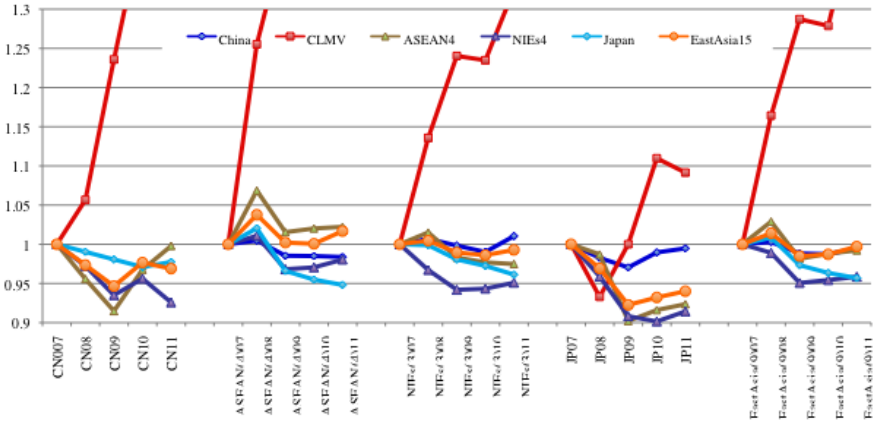
(a) Intra-regional imports in all products



(b) Intra-regional imports in machinery parts



(c) Intra-regional imports in machinery final products



Source: author's calculation, based on data available from UN comtrade.

ENDNOTES

[1] Although international production/distribution networks have been formed in other regions, the networks in East Asia, mainly in machinery industries, are distinctive in (i) their significance in each economy, (ii) their geographical extensiveness, involving many countries at different income levels, and (iii) their sophistication in both intra-firm and arm's length (inter-firm) relationships (Ando and Kimura, 2005).

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

[3] In this paper "machinery goods" are composed of general machinery, electrical machinery, transport equipment, and precision machinery (Harmonized System (HS)84-92) in this paper. See Ando and Kimura (2012) for the definition of machinery parts and components.

[4] See Jones and Kierzkowski (1990, 2001), Arndt and Kierzkowski (2001), and Deardorff (2001) for fragmentation theory.

[5] East Asia in Figure 3 is the East Asia 10, including China, the ASEAN4 (Indonesia, the Philippines, Thailand, and Malaysia), the 4 Newly Industrializing Economies (NIEs4) (Korea, Hong Kong, Singapore, and Taiwan), and Japan. See Ando (2010) for the corresponding figures for imports.

[6] In the 1990s, vertical transactions, particularly back-and-forth transactions in parts and components in vertically fragmented production processes across borders, rather than the trade of quality-differentiated commodities that is supported by the theoretical model of intra-industry trade with vertical product differentiation, were drastically expanded in East Asia (Ando, 2006).

[7] The East Asia 9 consists of the East Asia 10 excluding Taiwan. The East Asia 15 is composed of China, the ASEAN10, Korea, Hong Kong, Taiwan, and Japan. Due to the availability of data, we set the trading countries as the East Asia 9 and trading partners as the East Asia 15. Note that Taiwan is not explicitly included in the UNcomtrade database, but trade with Taiwan is said to be close to that for "other Asia, not elsewhere specified (nes)" (shown only as a partner country). Therefore, Taiwan is included here as a partner, considering that Taiwan is one of the important economies for regional production networks. The CLMV countries are Cambodia, Laos, Myanmar and Vietnam.

[8] The number of products is expressed as an index based on the number in January 2007; the number of exported products, for all products at the HS 6-digit level was 39,069, and the corresponding number of imported products was 43,057.

[9] The number of exported product-country pairs for intra-regional trade of all products at the HS 6-digit level in January 2007 was 252,865, and the corresponding number of imported product-country pairs was 228,531.

[10] Figure A.1 in the Appendix represents the number of exported product-country pairs by destination for intra-regional exports of each country/group in East Asia; exporting countries/groups are China, the ASEAN 4, the NIEs 3, Japan, and the East Asia 9.

[11] See Figure A.2 for the corresponding number of imported product-country pairs by origin for intra-regional imports of each country/group.

[12] The decomposition approach allows us to decompose the percentage change in the total value of trade into the quantity effect, the price effect, the entry effect, and the exit effect. The quantity/price effects, i.e., intensive margins, are changes in trade due to changes in quantity/price for product-country pairs that continue trade. On the other hand, the entry effect and exit effect, that is, extensive margins, are changes in trade (an increase in trade values) due to trade for new product-country pairs and changes in trade (a decrease in trade values) due to trade for exiting product-country pairs, respectively. See Ando and Kimura (2012) for more detailed results and discussion.

[13] 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].

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