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Japan and Economic Integration in East Asia: Post-disaster scenario[*]

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Abstract

As regional integration proceeds in East Asia, intermediate goods production of advanced technology has been locked in Japan despite the dispersion forces of high factor costs. However, the disastrous earthquake in 2011 may have revealed supply chain disruption risk as another dispersion force. We analyze how these dispersion forces affect the specialization in intermediate goods production of Japan and discuss future competitive challenges for the Japanese economy under deindustrialization from the spatial economics viewpoint.

Keywords: agglomeration, dispersion, lock-in, supply-chain disruption risk,
East Asian economic integration.
JEL classification: F15, R11, O53

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1. Introduction

Over the past half century, trade costs (broadly defined) have been steadily reduced through continual improvement in transportation and information technologies, together with the continuing efforts to lower institutional barriers in international trade, investment, and finance. The technological and institutional changes have been particularly remarkable in the last two decades, and have been significantly influenced by the diffusion of the internet and the formation of the network of free trade agreements. These factors have contributed to changes in the spatial configuration of the global economy, which have led to a sequence of structural changes that have evolved toward an increasingly complex system of the production network.

East Asia has benefited from globalization without a doubt. Figure 1 shows that, since the turn of the century, East Asian exports of final goods (consumption and capital goods) to the rest of the world have expanded quite rapidly. Although the growth of final goods trade within East Asia has been relatively modest, regional integration has been driven mainly by the trade of parts and components that has increased in unison with the growth of final goods exports to the rest of the world. The expansion of East Asian extra-regional consumption goods exports can be largely attributable to China, whose share increased from 15% in 1990 to 59% in 2009; whereas China and ASEAN countries import respectively about 30% and 26% of intra-regional intermediate goods trade in 2007-09. This graph illustrates East Asia as the global core of manufacturing, within which parts and components are intensely traded. Although Japan represented about a half of intra-regional intermediate goods exports in the beginning of 1990s, the share has declined to 22% in 2007-09 because of rapid growth of exports from Korea, Taiwan, ASEAN and China.

There are uncountable numbers of studies on East Asian integration. Kojima (2000) presents a comprehensive review of the standard "flying geese" paradigm of Asian development based on the international division of labor. It describes the diffusion of industrialization in the region as following a pattern whereby leading countries such as Japan progressively specialize in technologically advanced industries while ceding those in which they were losing comparative advantage to countries that were latecomers in industrialization. That paradigm has been challenged, however, by the ongoing processes of the international fragmentation of production (Kimura and Ando 2005; Athukorala and Yamashita 2006), offshoring of labor intensive activities (Wakasugi et al. 2008), and globalization of supply chain (Fujita and Thisse 2006), which are leading to intra-industry vertical specialization.

This paper has two objectives. First is to provide the logic of interpreting the current wave of regional integration in East Asia from the perspective of spatial economics, or the new economic geography, by illustrating how agglomeration and dispersion forces interact. Second is to contribute to the literature of spatial economics by adding natural disaster risks as a source of dispersion forces, particularly when production is vertically linked and there exists a threat that any disruption at a critical node will hinder the entire supply chain. In this regard, we draw certain lessons from the experience of the Great East Japan Earthquake on March 11, 2011.

The next section provides a brief review of agglomeration and dispersion forces in spatial economic theory. In section three, drawing on our previous study (Fujita and Hamaguchi 2010), we explain how current East Asian integration is characterized by intra-industry vertical specialization. Under this structure, Japan provides advanced intermediate goods to developing Asian countries, where more labor-intensive activities are conducted. However, that role may not be sustainable in the long run, particularly when supply chain disruption risk from high impact natural disasters is conceivable. We address this issue in section four. The final section discusses certain implications for regional policies in Japan that, in our view, faces a more serious threat from deindustrialization after the great earthquake.

2. Agglomeration forces and dispersion forces

Spatial economics provides a useful framework to analyze the dynamic transformation of spatial economic systems by cutting across traditional boundaries of cities, regions, and countries. The observed spatial configuration of economic activities is understood to be the outcome of a process involving agglomeration forces and dispersion forces. As a balance of these two forces, a variety of spatial structures of an economy may emerge. Thus, spatial economics focus on the self-organization of economic geography, as opposed to many fields in economics that treat it as exogenously given.

From this perspective, the fundamental questions are how to explain agglomeration forces and dispersion forces. The latter can be readily answered by traditional economic theory. The concentration of economic activities at a location will naturally increase factor prices (such as land prices and nominal wages) and generate congestion effects (such as traffic congestion and air pollution), which reduce firms' profit and residents' utility level. Thus, the principal concern of spatial economics is how to explain agglomeration forces. Broadly speaking, the idea proposed by Fujita, Krugman, and Venables (1999) is shared by many researchers: that is, agglomeration results from the interaction among increasing returns at the individual firm-level, transport costs (broadly defined), and factor mobility.

Fujita (2007) describes three basic concrete patterns of such interactions. First, we can consider a large variety of consumer goods. In response to scale economies, the production of such goods tends to locate in larger markets (= cities). As a result of lower transport costs, people can consume at lower prices in cities, where, for a given nominal wage, real income becomes higher than that in more distant places. This, in turn, induces more workers (= consumers) to migrate to cities. Subsequently, as the cities' population increases, their home markets are magnified, enabling an even larger variety of consumer goods to be produced in cities, which will further enhance real income.

Second, we can consider a large variety of intermediate inputs. Because of the scale economies, suppliers of such goods tend to locate in areas where final goods firms (= customers) are concentrated. On the other hand, it is convenient for final goods firms to locate near input suppliers as much as possible to avoid transport costs. This, in turn, induces more final goods firms to move to such locations. As a result, great demand is created for diverse intermediate and producer services, prompting more firms to locate there because of easy access to their customers and increasing diversity in intermediate goods; hence, the agglomeration proceeds with a snowball effect. The process of co-agglomeration of input suppliers and final goods firms through this interaction partially explains not only the industrial cities specialized in machinery production and characterized by multilayered vertical integration but also modern metropolises crowded with corporate headquarters, research and education institutions, and specialized business services.

Third, focusing on the diversity of knowledge among workers, we can observe the agglomeration of brain-powered workers and innovation activity in today's major cities. Due to the fixed costs involved in acquiring certain types of knowledge, brain-powered workers are attracted to working in collaboration with those with complementary knowledge; creating opportunities for each brain-powered worker to utilize his/her own knowledge to a greater extent. Because knowledge exchanges call for face-to-face communication, these workers tend to agglomerate. Furthermore, better access to more diversified knowledge provides higher productivity in innovation activities, which induces more innovation activities/institutions to locate closer to larger pools of brain-powered workers. The resulting increase in innovation activities creates demand for an even greater variety of brain-powered workers.

On the basis of the aforementioned understanding of agglomeration and dispersion forces, Fujita, Krugman, and Venables (1999) showed that transport costs play a key role in determining the spatial system of an economy. It is noteworthy to recognize that transport costs refer to many different types of costs that are involved in the movement of goods, services, people, money and capital, as well as information, knowledge and technology. With regard to the international trade of goods, we must consider, in addition to the usual freight costs, many other forms of trade costs such as tariff and non-tariff barriers, exchange rate variation, and costs arising from different languages and cultures, many of which are often difficult to quantify.

We may exemplify an extreme case in which transport costs are prohibitively high. Producers of differentiated consumer products, intermediate inputs, and those with differentiated knowledge have no choice but to disperse themselves in proportion to local demands arising from the immobility of certain factors (due to the existence of activities attached to the land or delimited by national borders, for example), giving away cost savings from scale economies. Now, consider that transport costs decrease gradually. Then, at a certain period of time, the circular causation in spatial agglomeration starts working. The lower are transport costs, the smaller is the number of agglomerations and the bigger is the size of each agglomeration. As remarked by Fujita and Thisse (2002, p.129), "the trade-off between increasing returns and transportation costs is fundamental for the operation of a spatial economy." With a further reduction in transport costs, however, the aforementioned dispersion forces come to light. That is, as the reduction of transport costs gives rise to the formation of the large agglomeration of economic activities, prices of land and labor become higher and congestions are exacerbated. In response, those activities that use labor or land intensively start moving to peripheral places to achieve cost reductions without seriously losing scale economies because distance is an irrelevant obstacle for sales under substantially low transport costs.

In addition to the role of transport costs, the existence of lock-in effects influence spatial economics. These effects arise from the self-reinforcing mechanism of agglomeration that induces individual economic agents to avoid changing location, even though such deviation is possible in the presence of multiple equilibria of spatial patterns. Lock-in effects have the following implications. First, they show that history matters in the development of a particular region. That is, historical incidences give influence to actual industrial location patterns. In the presence of the aforementioned self-reinforcing mechanisms, any temporary shock may have a permanent effect on industrial location patterns. Second, while lock-in effects can promote a snowballing acceleration of agglomeration in a particular region in its early stage of development, it may demobilize a saturated situation, thus, hampering sustained development in the long run. We may observe the latter problematic case in certain traditional industrial cities suffering lower productivity due to high factor prices and congestion. In another instance, in case degradation of living conditions in a city prevents the inflow of fresh, brainpowered workers, while the incumbents are locked-in, the productivity of research and development in the city decreases because knowledge exchanges continue to be made only among the same members, leaving less room for learning among the workers (Berliant and Fujita 2008). In this context, regional development policies should be concerned with avoiding the trap of negative lock-in effects.

3. Regional integration in East Asia

At the global level, while the traditional two economic cores—that is, Europe and North America—hold the leading positions, East Asia has emerged as the third core, assuming the role of the primary exporter of industrial products. Figure 2 shows that the world share of GDP of the three cores increased from 80% in 1990 to 94% in 2002, and then decreased to 75% in 2010, while we observed a catch-up in GDP in East Asia against that of the EU and NAFTA[1]. The three core economies claimed 82% of world exports in 1990, with this share increasing to 85% in 1998 but then gradually declining to 76% in 2010, while East Asia's share continued to rise from 21% in 1990 to 30% in 2010[2]. The increasing participation of non-core economies in both GDP and trade also reflects the growing presence of India and certain natural resource-based economies.

It is also notable that there have been remarkable changes in economic balances within East Asia. Japan, the traditional regional core economy, has lost its weight in the region substantially between 1990 and 2010, when its influence fell from 71% to 37% of GDP and from 41% to 17% of exports. In contrast, China expanded its regional share from 9% to 40% of GDP and from 9% to 35% of exports, surpassing Japan as the regional leader. During the same period, the regional share of ASEAN's GDP increased gradually from 8% to 12%, while that of exports, facing competition from China, first increased from 20% in 1990 to 26% in 1996 and then declined slightly to 23%. Korea and Taiwan maintained their regional shares of GDP and exports over the two decades.

The rise of economies of China and ASEAN can be partially attributed to the growth of foreign direct investment (FDI) from Japan. Besides increased factor costs

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[1] These calculations are based on the GDP figures in current US dollars from the World Economic Outlook database of the IMF.

[2] Export figures are calculated from the WTO statistical database.

and congestion caused by agglomeration in Japan, the appreciation of the yen against the dollar, occurring in several waves over the years (1990–95, 1999–2000, 2002–04, and 2007–11), has accentuated the production cost difference between Japan and developing Asian countries. In response, Japanese firms have launched internationalization efforts and dispersed production mainly within East Asia. According to the *Basic Survey of Overseas Activities* (Ministry of Economy, Trade and Industry), the number of Japanese overseas manufacturing affiliates in Asia (including South Asia in this case) has increased from 3,920 in 1997 to 6,154 in 2009 (representing a 57% increase, which is two times greater than the 28% growth in total global overseas affiliates). Over the same period, permanent employment in Japanese overseas manufacturing in Asia has almost doubled from 1.43 million to 2.82 million. In contrast, total employment in manufacturing in Japan declined by 2.83 million between 1997 and 2007 (from 14.45 million to 11.62 million), according to the *Labor Force Survey* (Ministry of Internal Affairs and Communications).

In the process of internationalizing production, previously integrated production processes were split into several units on the basis of factor intensity differences; this optimization behavior results in the location choice of each unit in different countries, in accordance with the factor endowment of each country. Most typically, labor-intensive final assembly is located in low wage developing countries, while advanced intermediate goods are produced in industrialized countries. This trend known as *fragmentation* has been emphasized in empirical research on international trade in East Asia (Kimura and Ando 2005, Athukorala and Yamashita 2006).

The vertical intra-industry specialization pattern between Japan and developing Asian countries is different from the traditional flying geese paradigm of an inter-industry division of labor. Under the latter, as depicted in Figure 3 (left), Japanese FDI transferred those industries that Japan no longer had a comparative advantage in to developing Asian countries, while Japan shifted its own production resources to more capital-intensive (or technology) industries. The specialization enhanced efficiency in both Japan and developing Asian countries, realizing significant scale economies that resulted in massive exports to outer markets (mainly Europe and North America) and paved the way to export-led high growth.

Under the recent specialization pattern, depicted in Figure 3 (right), developing Asian countries' exports of final products to global markets induce imports of intermediate goods from Japan as well as from Korea, Taiwan, and Singapore, leading to the expansion of intra-regional trade volume, as depicted in Figure 4. Dean et al. (2011) shows that although China's export composition has become so diversified that it includes highly sophisticated products similar to that of OECD countries, more high-tech products tend to depend on an Asian supplier network, while Chinese industries are more vertically specialized in labor-intensive stages of production. As Athukorala and Yamashita (2006) point out, it is worth noting that despite growing intra-regional trade in East Asia, the region's dependence on extra-regional markets in final goods demand has not been reduced but, on the contrary, has increased.

From the perspective of spatial economics, the following comments are in order. First, fragmentation has been helped by the dispersion force of high costs in Japan and reductions in intermediate goods transport costs. In this process, final production did not disperse evenly across developing Asian countries but was concentrated in a limited number of locations that provided high market potential, where higher quality infrastructure contributed to the improvement of access to outer market consumers and to a reduction in the cost of receiving regionally supplied intermediate goods[3].

Second, dispersions of final production have been accelerated by local demand in developing Asian countries and resulting agglomeration forces based on scale economies. In these countries, relatively young and fast growing, middle income populations constitute the most vigorous consumer demand. For example, locations of foreign firms in China have been strongly influenced by local factors such as the existence of parts suppliers of the same countries of origin[4], infrastructure, and human capital quality (Wakasugi 2005), which foster production cost advantages for exports to the outer region markets. However, as local demand turns out to be a more decisive factor in the market potential of an investment project, location decisions will be more influenced by access to the local population. In the case of China, in particular, firm locations will be more directed toward places inland from a coast because the Chinese population is spatially dispersed due to its migration control policy[5].

Third, Japan's position as an intermediate goods provider may be uncertain. The existing agglomeration of critical parts as well as materials manufacturers and production machinery manufacturers is serving as the source of agglomeration forces that lock in entire advanced manufacturing industries in Japan. However, due to not

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[3] International production dispersion contributed to a reduction of income gaps among nations, while regional income disparities have become a serious concern in certain countries, particularly in China. See Hamaguchi and Zhao (2011).

[4] Belderbos and Carree (2002) and Depaere et al. (2010) studied the case of Japanese firms' and Korean firms' FDI locations, respectively.

[5] In 2009, Hewlett-Packard invested in Chongqing for the production of notebook PCs jointly with Foxconn's LCD display factory. Recently, Honda announced the expansion of its automobile plant in Wuhan. The both investment are reportedly designed to capture the local demand in inland China.

only the dispersion force from high factor costs in Japan but also growing scale economies in developing Asian countries, intermediate goods production may be induced to co-agglomerate with final goods production. The eventual loss of the accumulation of critical parts and materials manufacturers or production machinery manufacturers would significantly undermine the source of competitive advantage of Japan's advanced manufacturing industries, marking a severe blow to a country that has already lost its competitive advantage in widespread technology-based mass production. Certainly, Japan's innovative intermediate goods are highly differentiated such that many may not be produced without the agglomeration of brainpowered workers. However, as described in the previous section, the productivity of innovation depends on whether Japan will be able to maintain knowledge diversity. This will require attracting brainpowered workers internationally.

4. Supply chain disruption risk as another dispersion force

On March 11, 2011, the most powerful earthquake ever recorded in Japan, with a 9.0 magnitude, occurred off the coast of Miyagi prefecture in the Tohoku (Northeast) region. It triggered a destructive tsunami that hit an extensive area on the coast of the Tohoku and the northern Kanto regions (Figure 5). The 3/11 disaster resulted in more than 15,000 human lives lost and almost 5,000 people remain missing, in addition to severe damage to physical infrastructure. It further prompted critical nuclear power plant accidents in Fukushima prefecture. Because of radioactive releases, about 90,000 local residents have been forced to evacuate from their native area for an indefinite period. The uncertainty of electric power supply may mark a severe blow to the manufacturing sector, whose competitiveness has already been weakened because of a strong yen in the last couple of years.

The disaster has had an immediate impact on the Japanese economy. Although the Tohoku region represents only 6.4% of Japan's GDP and just 1.0% of total exports in 2008, the impact of the disaster appeared to be unexpectedly large. National GDP in the second quarter of 2011 plunged by 2.1% compared to the same period in the previous year, while industrial production and exports dropped even more sharply by 7.0% and 8.0%, respectively.

The magnitude of the economic impact is partially attributable to supply chain disruptions. The disaster-affected area serves as a major source of supply chain flows of goods (from the procurement of parts to the delivery of finished products) to support Japan's manufacturing industry. Failures of parts and materials delivery from this area have forced many manufacturers—ranging from assembling manufacturers such as automobile and electric appliance makers to other parts and materials makers—across the country to suspend their operations as well. As shown in Table 1, more severe losses were experienced by the automobile industry (buses, passenger cars, motor vehicle parts, and trucks), the electronic equipment industry (household electronic machinery, communication equipment, other information and communication electronic equipment, and integrated circuits), and the metal industry (metal products for building, non-ferrous metal casting, and refining of non-ferrous metals). These industries particularly depended on key parts and basic materials produced in the disaster-affected area. Figure 6 reports that Japanese automobile production in March 2011 was 57.3% less than that in the same month last year. However, if we assume that firms had produced normally until March 11th, the impact following the disaster could have been as large as the -85.7%[6], implying that the automobile production in the remaining period of March was just about three days production level in the previous year. We can infer that immediately after the disruption, automobile producers with a just-in-time procurement policy (therefore basically no parts inventory) could produce cars only by scrambling up parts in production processes that lasted only three days.

The impact was not limited to within Japan. For example, in places where Japanese automobile makers have a strong presence, intermediate goods shortages caused a sharp drop in automobile production with certain time lags, such as one month after the earthquake in Guangdong province of China and the next month in Thailand, as shown by Figure 6. It is notable that the speed of the contagion of shocks was slower in Thailand, which is farther from Japan. This is because firms tend to hold more of imported intermediate goods in safety stock in case of a sudden interruption in supply. The recovery was also slower in Thailand than in Guangdong because of time lags in the arrival of imported parts.

Systemic problems may occur when a natural disaster destroys critical nodes in a supply chain wherein production of particular parts and components is concentrated within a few suppliers. Such concentrations are self-organized as we can explain using the same logic as for a spatial economy: i.e., low transaction costs and scale economies. Although Japanese automobile companies have sought to increase procurement from

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66 Assuming that, as in February, the production by March 11 was 5.5% less than March 2010 (= 945,271 units), we consider that Japan produced by March 11 945,271*(1-0.055)*11/31=316,971 units of vehicles that is 85.7% less than 945,271*20/31. Subtracting this from the actual figure of March (=404,039), we obtain that 87,069 units were produced after the disaster, which corresponds to about 3 days production in 2010 March.

multiple sources, it is not possible to fully control procurement concentration at lower tier suppliers. It is more likely that concentration occurs when scale economies matter, particularly if parts are so expressly customized that firms cannot place bulk orders. To further complicate matters, when the disruption occurred, it was impossible to find replacements from other suppliers, at least in the short run, because of a high degree of customization. A typical example in the 3/11 disaster was the Renesas Electronics' Naka plant located in Ibaraki Prefecture. It produces a micro control unit (MCU) for high quality motor vehicles that makes extensive use of electronic control technology. Over the years, Renesas has become a supplier of customized MCU for major automobile companies in the world[7]. The shutdown of the plant caused a sharp drop in automobile production in Japan during the second quarter.

If concentration increases the potential risk of disruption for the entire supply chain in the case of high impact/low probability events, we might find another case of dispersion forces. Dispersions in this case may involve: building safety stocks (dispersion of products); use of multiple suppliers; and duplication of production facilities. These actions aimed at increasing redundancy and resiliency are called business continuity plans (BCPs) and they receive great attention in the literature of supply chain management (see Sheffi and Rice Jr. 2005).

However, individual firms are rarely capable of taking significant actions to mitigate the potential loss from the supply chain disruptions because they are generally reluctant to assume costs from the loss of scale economies. However, the 3/11 disaster was not the first supply chain crisis in East Asia. The significant earthquake in Taiwan in March 2000 shut down large liquid crystal display factories agglomerated around the Hsinchu Science Park. The outbreak of the SARS epidemic in southern China in 2002–03 sent further ripples through the global supply chain. Japan itself also suffered disruptions after the Great Hanshin-Awaji Earthquake of 1995 and the Chuetsu Offshore Earthquake in 2007. Yet, certain critical nodes still widely exist[8]. Most recently, in October 2011, Japanese manufacturing firms suffered serious supply chain disruption by Thailand's worst flood in 50 years. Thailand has been one of main recipients of Japanese firms' investment not only for the final assembly but also as a production base of intermediate goods particularly for the production of pickup trucks and hard-disk drives.

Previous research has already pointed out why firms fail to incorporate the cost of

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[7] According to the *Financial Times* (April 1st, 2011), Renesas claims a 40% share of the world market for MCU used in cars.

[8] For example, almost 40% of DRAM production capacity in the world is concentrated in the surrounding regions of Seoul. We thank Ho-Yeon Kim for confirming this figure.

high impact/low probability events. In the case of a low probability event, it is hard to learn from past experiences, potentially making our predictions more diverse and imprecise. Moreover, uncertainty will be high in decision making because the valuation of risks is difficult. Suppose that firms have heterogeneous beliefs about high impact/low probability events. Optimistic managers may consider that the probability is just once in one thousand years, while pessimistic managers assume that it would be once in one hundred years. While firms of the latter type consider that it is necessary to introduce BCP to implement a project, optimistic managers concentrate on production without hesitation. Scale economies and ignorance of BCP costs will make optimistic firms' market power favorable; thus, market competition leads firms to seek the benefit of agglomeration without paying costs for preventive measures. This resembles Miller's (1977) argument regarding the capital market consisting of agents with heterogeneous beliefs and restricted short selling. He found that in such a market equilibrium prices would only reflect the opinion of the more optimistic investor.

The agency problem also might be an issue. A risk conscious buyer may wish to enforce a BCP on its supplier in the business contract, but the supplier's implementation could be partial if monitoring costs are high.

However, the impacts of the 3/11 disaster were large enough to reduce the heterogeneity in beliefs, encouraging more Japanese firms to establish backup plants in overseas locations, or permanently relocate their production from Japan to overseas. According to METI (2011), supplier firm managers perceive that foreign customers and Japanese firms already producing overseas seek to reduce dependence on intermediate goods imports from Japan, while final manufacturers in Japan make more serious efforts to procure from multiple sources, including overseas suppliers. Thus, the 3/11 disaster came as a further blow to the Japanese manufacturing sector that was already threatened by high factor costs and a strong yen, although the lock-in effects of agglomeration economies from the intermediate goods variety had prevented a hollowing out.

5. Implications for post-3/11 disaster regional policies in Japan

In this paper, we have argued that agglomeration of critical intermediate goods supports lock-in effects that keep manufacturing industries located in Japan. The presence of advanced manufacturing industries in the Tohoku and northern Kanto regions has steadily increased since the mid-1990s as they have come to see greater advantage in locating their operations in these regions for a variety of reasons, which include: relatively cheap labor and land available in abundance; improved accessibility to the Tokyo metropolitan area owing to transportation infrastructure developments over the years; enhanced academic and research infrastructure led by Tohoku University; and the enthusiasm of local communities in supporting an industry in their region.

The 3/11 disaster occurred when the region was just about to take a more important position in fulfilling Japan's role as an advanced intermediate goods supplier to East Asia. The best possible strategy is apparently to return to the pre-disaster state as quickly as possible once plants and factories in the affected area are able to restore operations. However, only restoring the pre-disaster state is not necessarily enough to achieve the recovery of the local economy in a sustainable way. The Great Hanshin-Awaji Earthquake in 1995 caused disastrous damage to the Port of Kobe, which was locked in as one of the hubs of Asian container traffic. At the time of the earthquake, global ports were competing with mega facilities equipped with deep water berths, which other ports in East Asia such as Busan, Shanghai, and Kaohsiung were already equipped with, and thus had competitive advantage. It turned out to be impossible for the Port of Kobe to recapture the leading position once lost just by rehabilitating the port to its original structure.

Hence, analogical reasoning can be applied here. To prevent Japan's manufacturing industries from falling into the same fate as the Port of Kobe, it is imperative to carefully analyze the current global competitive conditions and think beyond the restoration of the pre-disaster structure. Once Japanese manufacturers' backup or substitute production in overseas locations gets into full motion and their overseas counterparts secure substitute suppliers, parts and materials suppliers in the Tohoku and northern Kanto regions will never be able to restore their product demand to the pre-disaster level, even if their plants and factories are rebuilt and restored to operation. The result would be the disappearance of jobs not only in the Tohoku and northern Kanto regions but all across Japan as well as a significant loss of agglomeration forces within the Japanese manufacturing sector as a whole. Moreover, failure in restoring manufacturing industries in the affected area could spell an ominous future for Japan.

We consider that Japanese regional policies need to redraw strategies based on the current environment of East Asian integration that has developed in the last few decades. For the most part, knowledge-based activities centered in core metropolitan areas and the mass production conducted in the countryside have been closely linked within Japan to provide advanced industrial products, mainly intermediate goods, to the East Asian production network. However, manufacturing jobs in the countryside, such as those in the 3/11 disaster-affected area, have recently become at risk because of high factor costs, the strong yen, and the conceivability of a higher risk of natural disasters. If these manufacturing activities were to disappear, there is no reason to be confident that the knowledge-based activities in core metropolitan areas will still remain without the nearby manufacturing base. In order to enhance plant-level competitiveness in the countryside, we will be able to learn from the German experience[9] in recovering labor productivity based on the 'coordinated economy model' where labor unions conceded the flexibilization of working conditions in exchange for guarantees of employment security and vocational training from employers with the approval of blockholder owners interested in long-term profit (Carlin and Soskice 2008). As in Germany, coordination was the hallmark of Japanese firms' behavior (Aoki 1990), although it has been substituted for arm's-length transactions under globalization. Increasing job securities will also contribute to boost domestic demand that will offset dispersion forces.

Regional policies can address these problems at three levels. First, agglomeration economies among brain-powered workers can be strengthened by enhancing living amenities that attract diversified, talented people globally. Second, production costs should be reduced through tax reforms and deregulation. There is also an urgent need to reinsure global markets that the electric power supply system will be safe and sustainable after the Fukushima nuclear power plant collapse. Third, if there is systemic fragility in *vertical* integration because of the endogenous formation of certain critical nodes in the supply chain, it will be beneficial for all participants in the supply chain to transform it to a *horizontal* one. That is, certain incentives should be given to physically disperse across East Asia the production of such products that are concentrated in the hands of a few suppliers. In this regard, Japan's acceptance of inward direct investment remains at a remarkably low level. To rebound, it must positively accept it, particularly in the countryside manufacturing regions, which could significantly benefit from investment from East Asian companies trying to realize advanced technological innovation by taking advantage of the brand attraction of products made in Japan.

References

Aoki M (1990) Toward an economic model of the Japanese firm, Journal of Economic Literature 28(1):1-27

[9] We are grateful to an anonymous reviewer for suggesting this viewpoint.

Athukorala P-C, Yamashita N (2005) Production fragmentation and trade integration: East Asia in a global context. North American Journal of Economics and Finance 17(3):233-256

Belderbos R, Carree M (2002) The location of Japanese investment in China: agglomeration effects, Keiretsu, and firm heterogeneity. Journal of the Japanese and International Economies: 194-211

Berliant M, Fujita M (2008) Knowledge creation as a square dance on the Hilbert cube. International Economic Review 49(4):1251-1295

Carlin W, Soskice D (2009) German economic performance: disentangling the role of supply-side reforms, macroeconomic policy and coordinated economy institutions. Socio-Economic Review 7:67-99

Dean JM, Fung KC, Wang Z (2011) Measuring vertical specialization: the case of China. Review of International Economics 19(4): 609-625

Depaere P, Lee J, Paik M (2010) Agglomeration, backward and forward linkages: evidence from South Korean investment in China. Canadian Journal of Economics 43(2): 520-546.

Fujita M, Hamaguchi N (2010) Regional integration of production system and spatial income disparities in East Asia. Jovanovic M International Handbook on the Economics of Integration Vol. 2. Edward Elgar, Chalterham:242-261

Fujita M, Krugman P, Venables AJ (1999) The spatial economy—cities, regions, and international trade. MIT Press, Massachusetts

Fujita M, Thisse J-F (2006) Globalization and the evolution of the supply chain: who gains and who loses? International Economic Review 47(3): 811-836

Fujita M, Thisse J-F (2002) Economics of agglomeration: cities, industrial location, and regional growth. Cambridge University Press, Cambridge

Hamaguchi N, Zhao W (2011) Economic integration and regional disparities in East Asia, Fujita M, Kuroiwa I, Kumagai S eds. The Economics of East Asian Integration: A Comprehensive Introduction to Regional Issues. Edward Elgar, Chalterham:

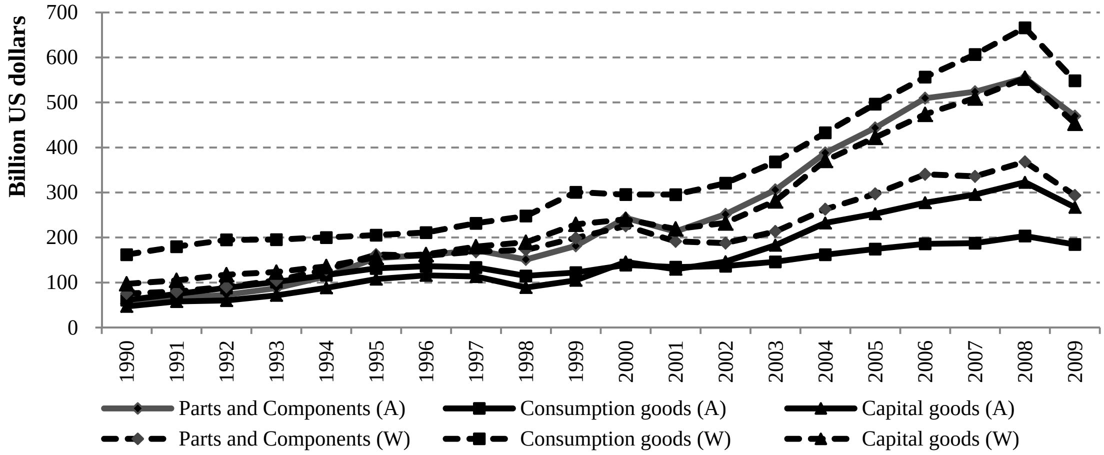
Kimura F, Ando M (2005) Two-dimension fragmentation in East Asia: Conceptual framework and empirics. International Review of Economics & Finance 14(3):317-348

Kojima K (2000) The "flying geese" model of Asian economic development: origin, theoretical extensions, and regional policy implications. Journal of Asian Economics 11: 375-401

METI, Results of an emergency survey on the actual status of industries after the Great

East Japan Earthquake http://www.meti.go.jp/english/press/2011/pdf/0801_03a.pdf
Miller E (1977) Risk, uncertainty, and divergence of opinion. Journal of Finance 32: 1151-1168.
Sheffi Y, Rice Jr. JB (2005) A supply chain view of the resilient enterprises. MIT Sloan Management Review 47(1): 41-48
Wakasugi R (2005) The effect of Chinese regional conditions on the location choice of Japanese affiliates. Japanese Economic Review 565(4): 390-407
Wakasugi R, Ito B, Tomiura E (2008) Offshoring and Trade in East Asia: A Statistical Analysis. Asian Economic Papers 7(3): 101-124

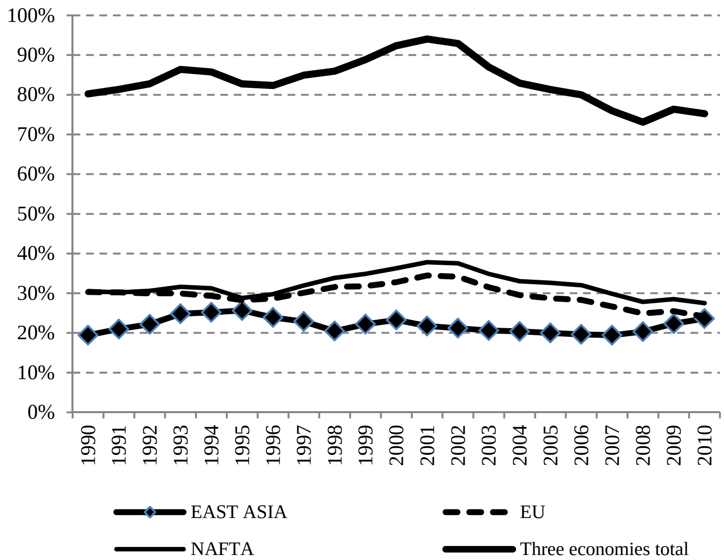
Figure 1 Evolution of East Asian exports by markets and categories



Note. (A) East Asia, (W) rest of the world

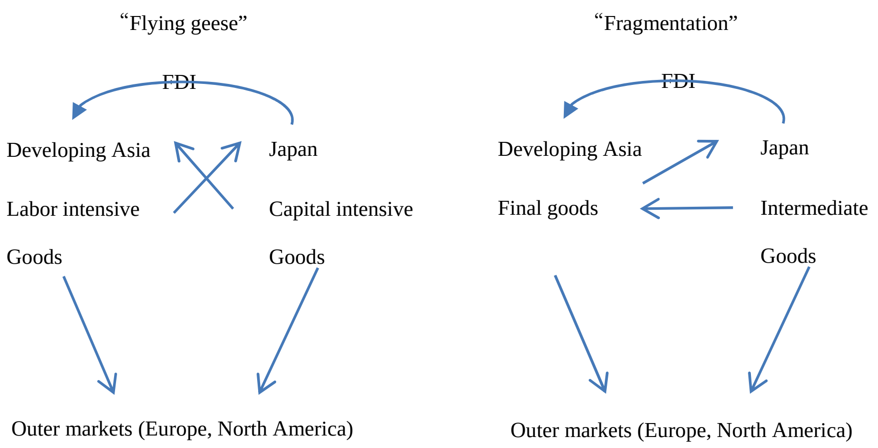
(Source) RIETI-TID 2010

Figure 2 GDP shares of the EU, NAFTA, and East Asia



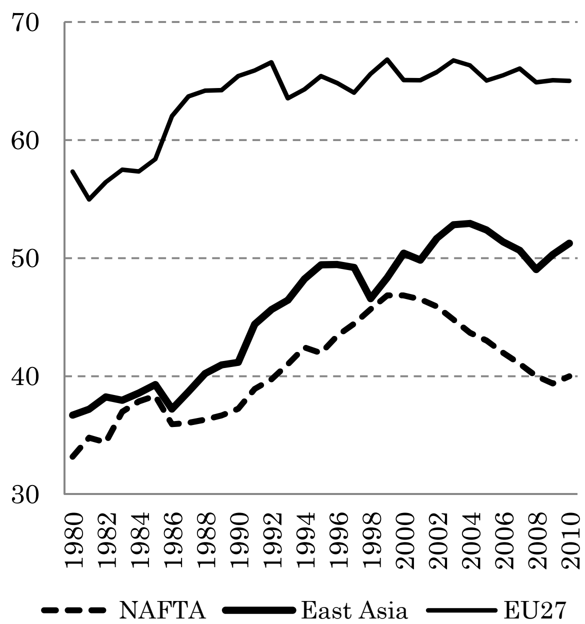
(Source) IMF, World Economic Outlook database

Figure 3 Two types of regional integration in East Asia



Note. Arrows represent most typical directions of exports.

Figure 4 Intra-regional trade shares of East Asia, the EU, and NAFTA



East Asia consists of ASEAN-10 plus China, Japan, Korea, Hong Kong, and Taiwan.
(Source) IMF, Direction of Trade Statistics and Taiwan

Figure 5 Great East Japan Earthquakes

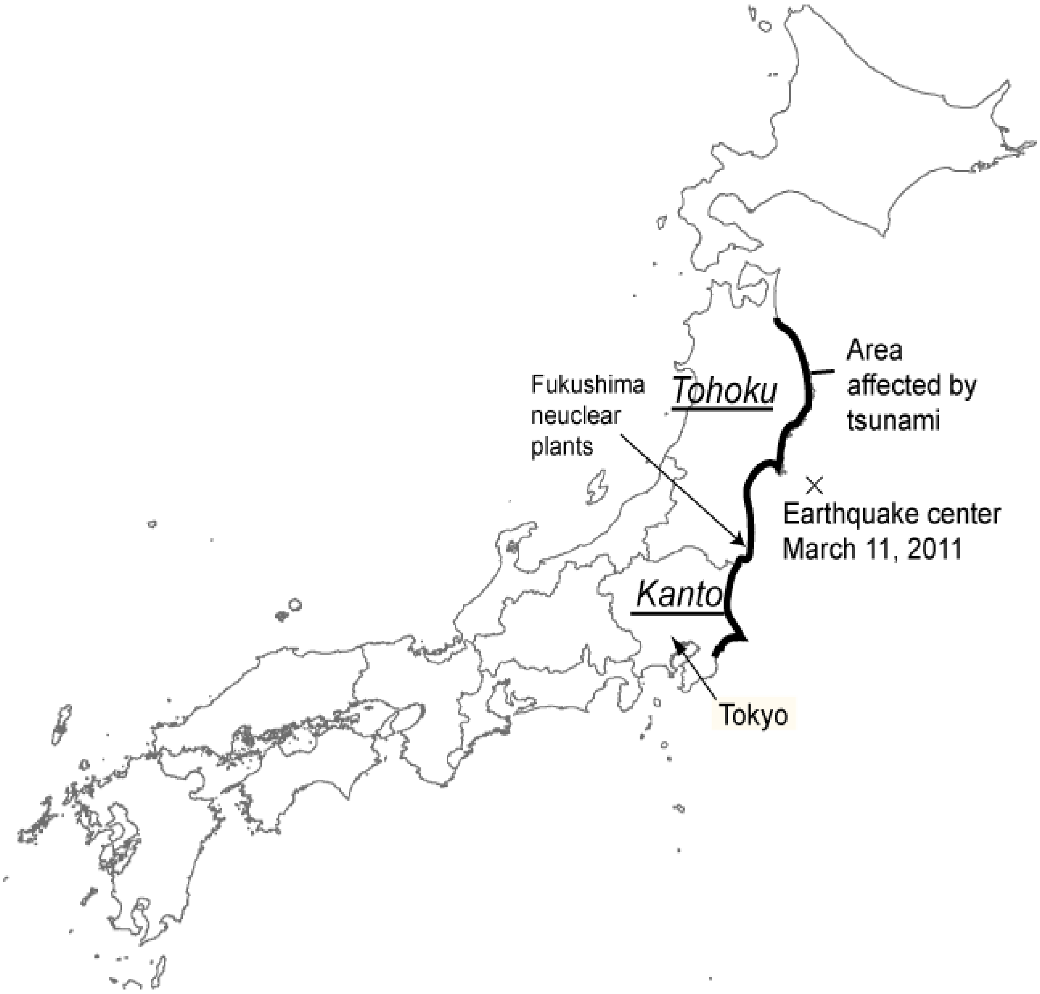
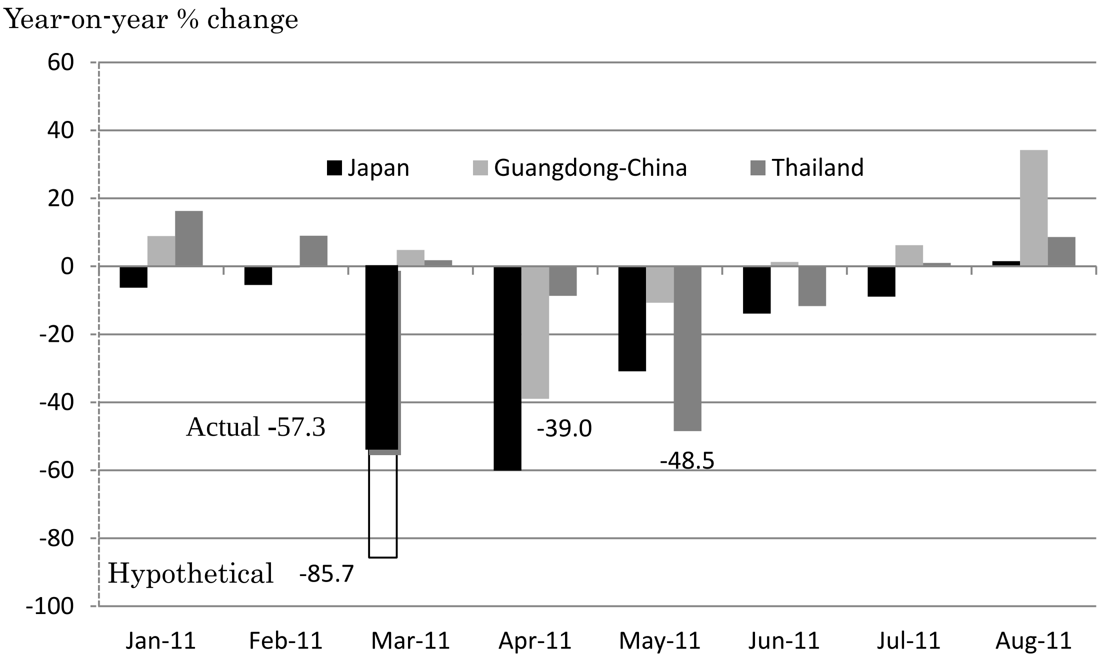


Figure 6 Automobile production monthly change in Japan, Guangdong, and Thailand in 2011



(Source) Japan Automobile Manufacturing Association, Statistics Bureau of Guangdong Province, Thai Automotive Institute

Table 1 Goods that suffered severe post-earthquake production falls

Goods	2011/2010 production fall rate (%)*	Value-added weights**
Buses	41.9	0.0017
Passenger cars	37.4	0.0855
Household electronic machinery	32.4	0.0129
Communication equipment	30.5	0.0150
Other information and communication electronics equipment	29.6	0.0030
Motor vehicle parts	27.4	0.0457
Trucks	24.2	0.0173
Integrated circuits	21.5	0.0316
Metal products of building	21.1	0.0087
Non-ferrous metal castings	20.7	0.0055
Chemical machinery	19.0	0.0012
Industrial inorganic chemicals, pigment and catalyst	17.6	0.0033
Processed vegetable and fruit products	16.7	0.0028
Refining of non-ferrous metals	16.2	0.0056

*Comparison of the second quarter. **Manufacturing total = 1

(Source) METI, Indices of Industrial Production Statistics Report