Economic Research Institute for ASEAN and East Asia

Policy Brief

Links with East Asia for a recovery from the Great East Japan Earthquake: Geographical Simulation Analysis

By Ikumo Isono and Fukunari Kimura

Japan is now struggling for a recovery from the devastating earthquake and tsunami of March 11, 2011. Although trunk logistic infrastructure has quickly been restored, some local infrastructure is likely to take a longer time to re-establish. The theory of new economic geography suggests that temporary interruption of infrastructure services may generate long-term negative effects on the Tohoku region and Japan as a whole because some of the economic activities may move away. We argue that strengthening links with East Asia is a key supplementary policy for achieving a full economic recovery. Our Geographical Simulation Model assesses economic effects of several policy scenarios.

1. Recovery and Long-term Impact

A huge (magnitude-9.0) earthquake hit East Japan on March 11, 2011. As a result of the earthquake, and the following tsunami and nuclear accidents, Japan was severely damaged socially and economically. It has been reported that 15,742 people died and 7,472 are still missing[1]. More than 100,000 buildings were fully destroyed, burnt, or washed away. There remain more than 100,000 evacuees[2]. A number of factories were physically destroyed by the earthquake, washed away by the tsunami, or damaged by flood or aftershocks. Many companies collapsed due to the disruption of their activities and/or to shrinking demand. Moreover, disruption from the earthquake in some crucial companies caused serious damage to production networks on a global scale, especially in the automotive and electronics industries.

In the short term huge efforts are required for recovery. The government has started implementing its first supplementary budget of $49 billion, and a second supplementary budget of about a half of this size is under preparation as of the beginning of July. The Fukushima nuclear plant, however, is not yet completely under control. Trunk transport lines have quickly been repaired; the damaged section of the Tohoku Expressway was re-opened on March 24, and service on the Tohoku Shinkansen high speed rail line between Tokyo and Shin-Aomori resumed on April 29[3].

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While speeding up the physical recovery, we should think of long-term impacts of the disaster, considering the behavior of firms and households. New economic geography (NEG) indicates that the movement of firms and households will change the relative attractiveness/competitiveness across regions and may irreversibly alter the whole economic structure. Some firms have already been destroyed or gone bankrupt. Furthermore, even if factories were not relocated from one place to another, a number of companies, particularly multinational automotive and electronics manufacturers and suppliers, might think of changing production ratios among various production sites, purchasing patterns among various sources, or their production systems. In this regard, reconstruction of damaged infrastructure will not automatically ensure a full recovery from the earthquake.

By using our Geographical Simulation Model (GSM) connecting ASEAN, China, India, and Japan, we can assess the long-term effects of the earthquake on East Asia and conduct policy analysis for minimizing the economic damage and achieving a full recovery. GSM is a simulation model based on a solid theoretical foundation of NEG. The model now includes 1,701 regions, more than 3,000 nodes, and 5,000 routes, comprised of road, sea, air, and rail networks. It contains physical transport costs, physical shipment and transshipment times, and tariff and non-tariff barriers. In the model, firms and households are engaged in economic activities and choose their preferable locations based on their profits and real incomes. Damage to infrastructure in Fukushima, Miyagi, and Iwate prefectures reduces the profits/real incomes of firms/ households in these prefectures, which leads to a "leakage" of some of the firms and households to other regions. A part of these firms and households may not permanently come back to Fukushima, Miyagi, and Iwate prefectures because their temporary movement may change the economic structure.

Key conclusions of our simulation exercise are twofold. First, a rapid reconstruction of infrastructure is crucial. If reconstruction were delayed, negative impacts in the long run would be large, due to a massive leakage of economic activities from the Tohoku area to West Japan or even from Japan to East Asia. Second, tightening a link between Japan and East Asia is essential. East Asia will certainly continue to grow, and thus some shift of economic activities to West Japan and China in the coming years will be inevitable. It will thus be important to implement policies to connect Japan with Asia more effectively. We propose the Mekong-India Economic Corridor (MIEC) as an example and see how such policy measures would revitalize the Japanese economy.

2. Scenario 0

GSM includes trunk logistics infrastructure connecting regions as well as local infrastructure such as local roads, communication infrastructure, electricity and water supply, and so on. We now observe a rapid recovery of trunk logistics infrastructure, such as expressways and the Shinkansen high speed train line, while local infrastructure needs more time to be re-built.

In scenario 0, we assume that trunk logistics infrastructure immediately recovers while technological parameter *A* decreases and recovers after some years. Parameter *A* includes elements as follows:

- Education level / skill level
- Logistics infrastructure within the region
- Communications infrastructure within the region
- Electricity and water supply
- Equipment in firms
- Utilization ratio / efficiency of this infrastructure and equipments

We set a 3-year recovery scenario and a 5-year recovery scenario as follows:

Scenario 0

3-year recovery scenario

1. 10% decrease in parameter *A* in 2011 and 3-year recovery in Fukushima, Iwate, and Miyagi prefectures. In these prefectures though, the parameters for Iwaki and Sendai decrease by 20%, and those for Engan-Iwate, Ishinomaki, Kesennuma, and Soso decrease by 30%.
2. 2% decrease in parameter *A* in 2011 and 2-year recovery in Tokyo, Chiba, Saitama, Kanagawa, Ibaraki, Yamanashi, Shizuoka, and Gunma prefectures.

5-year recovery scenario

3. 10% decrease in parameter *A* in 2011 and 5-year recovery in Fukushima, Iwate, and Miyagi prefectures. In these prefectures though, the parameters for Iwaki and Sendai decrease by 20%, and those for Engan-Iwate, Ishinomaki, Kesennuma, and Soso decrease by 30%.
4. 2% decrease in parameter *A* in 2011 and 2-year recovery in Tokyo, Chiba, Saitama, Kanagawa, Ibaraki, Yamanashi, Shizuoka, and Gunma prefectures.

In these scenarios, we assume a recovery in 3 or 5 years, including the infrastructure within each region (Figure 1). However, during the recovery period firms and households will reconsider the optimal location of factories and homes, and some will move away from Fukushima, Miyagi, or Iwate prefectures. Their migration will change the geographic distribution of economic activities, and the new geographic distribution will again affect the behavior of firms and households. As a consequence, firms and households may not come back to Fukushima, Miyagi, or Iwate prefectures permanently, even if the whole infrastructure were reconstructed.

Figures 2 and 3 illustrate the economic impacts of the earthquake in our simulation[4]. They depict GDP differences in 2030 compared with a fictitious baseline scenario where the earthquake did not occur. In Figure 3 the red regions get positive economic impacts while blue regions get negative impacts, compared with the baseline scenario. The simulation results from both 3-year and 5-year recovery scenarios suggest that firms and households will move out of Fukushima, Miyagi, and Iwate to other parts of northern Japan, such as Aomori, Yamagata, and Hokkaido, and/or to West Japan, and some of them will not return to Fukushima, Miyagi and Iwate

Figure 1. Changes in parameter A: Engan-Iwate, Ishinomaki, Kesennuma, and Soso regions

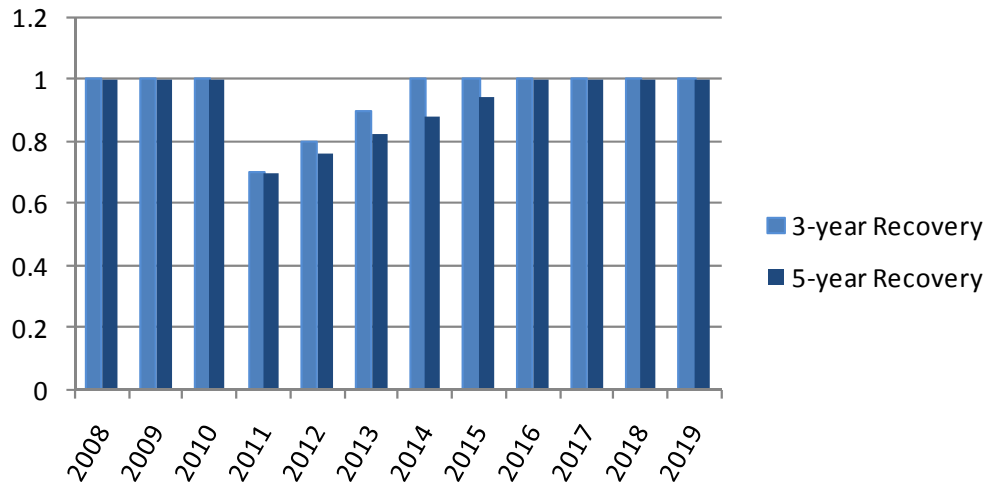


Figure 2. Economic impacts of the Great East Japan Earthquake in selected prefectures and regions in Japan (Scenario 0: GDP difference from the baseline, 2030)

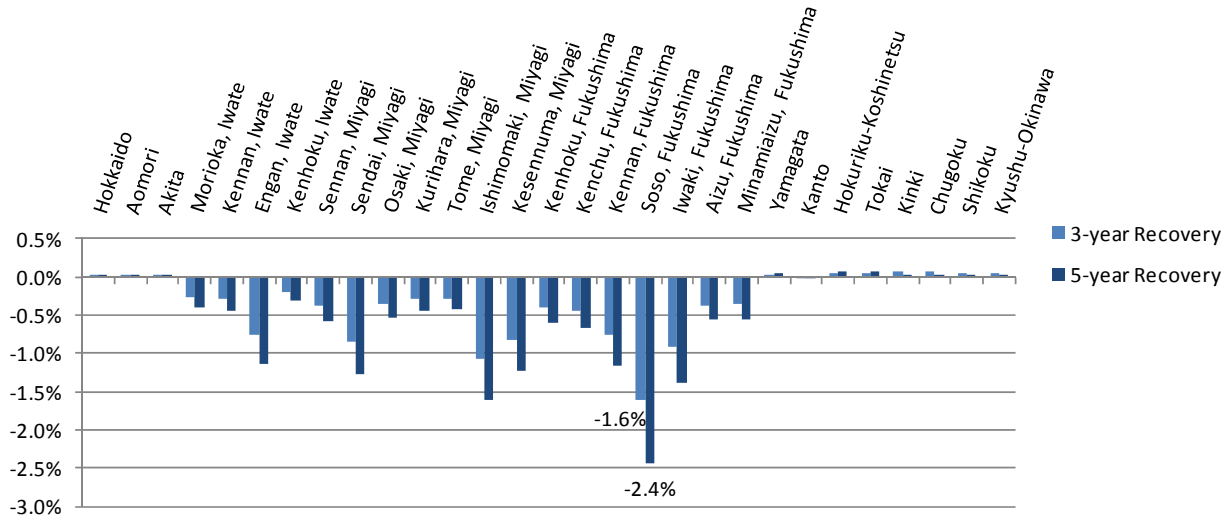


Figure 3. GDP difference in 3-year recovery scenario (Scenario 0 compared with the baseline, 2030)

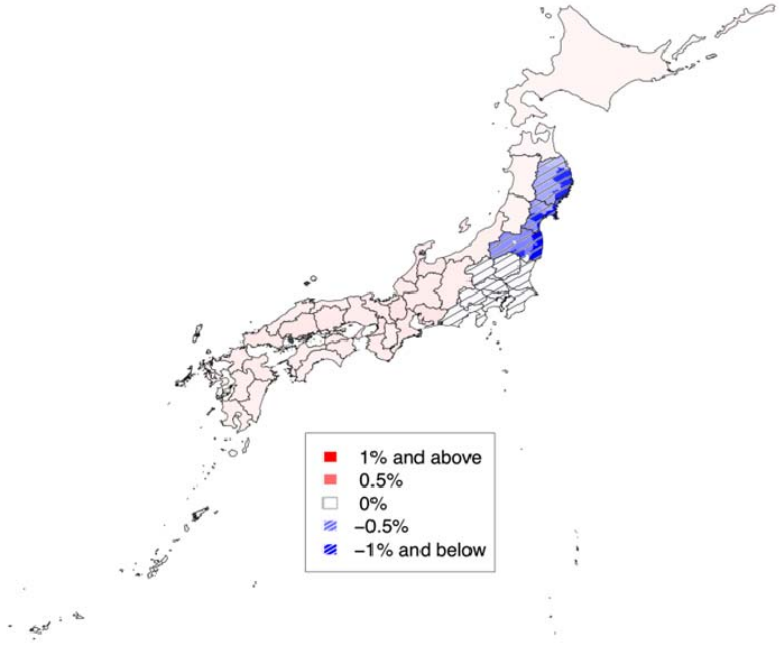
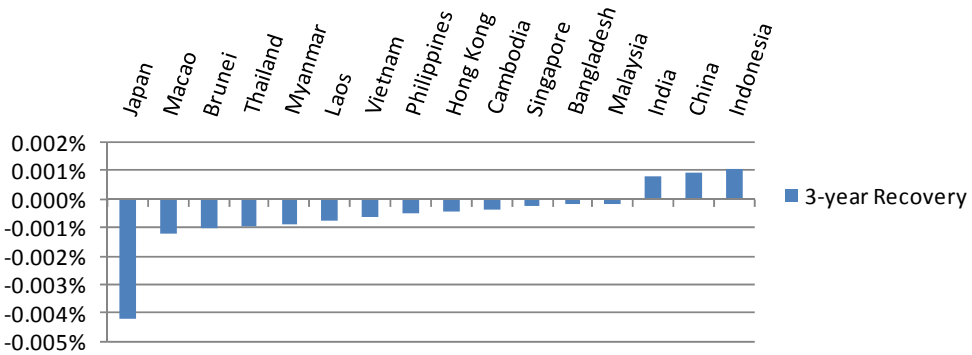


Figure 4. Economic impacts of the Great East Japan Earthquake in selected countries in East Asia (Scenario 0: GDP difference from the baseline, 2030)



prefectures. Soso, in Fukushima, will suffer a 1.6% loss of GDP in the 3-year scenario and a 2.4% loss in the 5-year scenario.

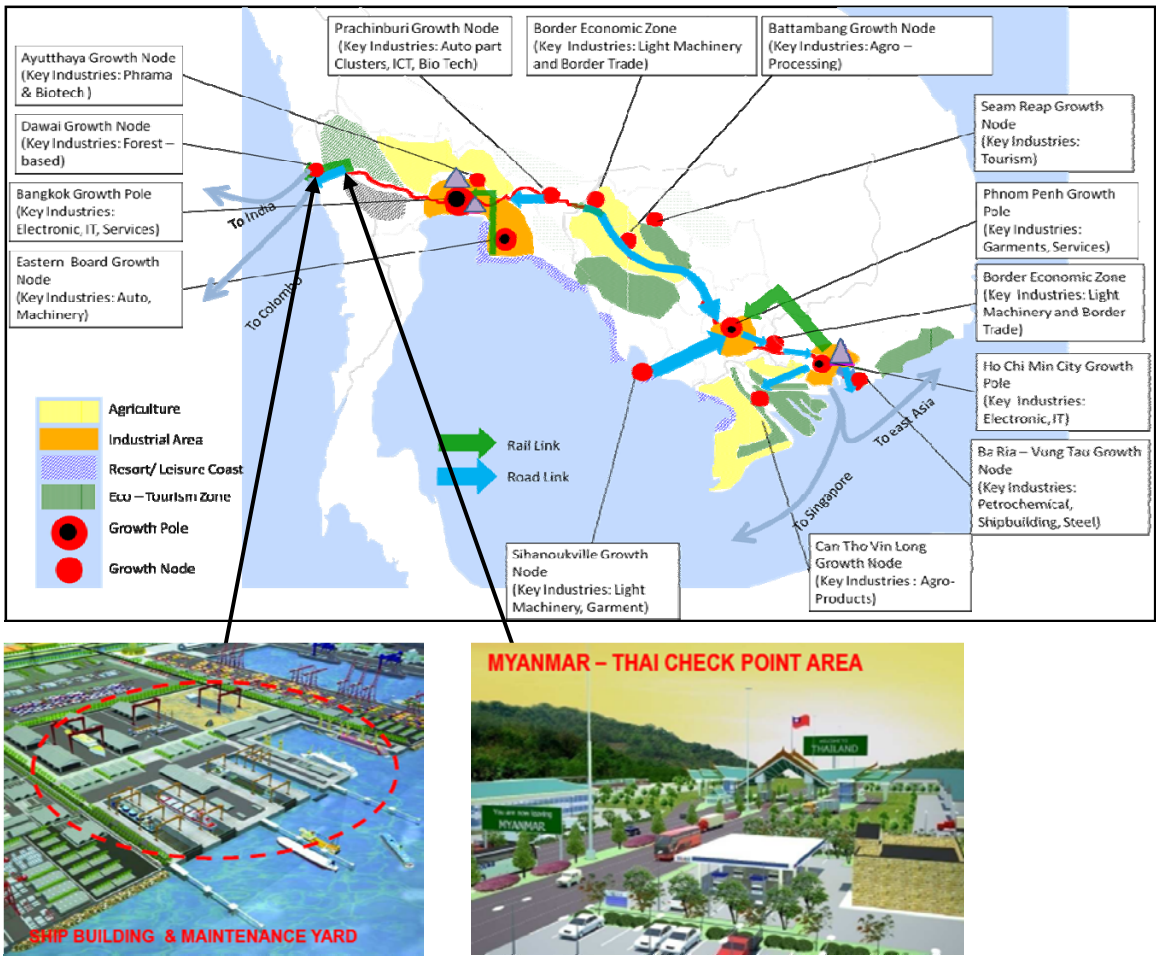
Negative impacts will also affect the whole Japanese economy because a gravity center of economic activities will shift from Japan to East Asia (Figure 4). In the 3-year recovery scenario, Japan will experience 0.004% loss of national GDP, compared with the baseline. Many ASEAN countries will also suffer slight negative impacts, while China, India, and Indonesia will have a higher GDP. We can conjecture that loosening competition with Japanese products will benefit India and Indonesia while China will gain from a shift of the gravity center of economic activities.

3. Scenarios 1 and 2

As we see in scenario 0, even if we just consider damage to local infrastructure that is rebuilt within 3 or 5 years, we will see rather serious negative impacts in the long run because of the leakage of economic activities from the Tohoku area and from Japan as a whole. These results remind us of the experience of Kobe where the port has permanently lost its position as a transport hub since the South Hyogo Prefecture Earthquake in 1995. A reinforced recovery plan is required to reduce such negative impacts and regenerate the competitiveness of the Tohoku area, and of Japan.

One key conclusion is that it would be beneficial to tighten links between Japan and East Asia. We will inevitably see a shift of some economic activities to West Japan and China in the coming years, and

Figure 5. Mekong-India Economic Corridor (MIEC)



Source: ERIA (2009) and Dawei deep seaport project.

thus policies to strengthen the connection between Japan and East Asia will certainly become crucial. This section raises an example in which the Mekong-India Economic Corridor (MIEC, Figure 5) will be developed and Japan will be connected to these fast growing regions more tightly. Such policies would yield positive impacts on Japan and lead to the achievement of a full recovery in the Tohoku region.

(1) Mekong-India Economic Corridor (MIEC) and link enhancement with Japan

MIEC passes through several rapid growing cities and towns, including Vung Tau, Ho Chi Minh City, Phnom Penh, Bangkok, and Dawei. MIEC also connects Dawei and Chennai through a new sea route. The economic corridor concept includes the construction of a new road between Kanchanaburi and Dawei and a new port in Dawei. Customs facilitation at the border between Kanchanaburi and Dawei to ease the border crossing, especially for transactions between Thailand and India, will enhance the positive economic impacts.

First, we assume the scenario in which Sendai airport and Tan Son Nhat airport in Ho Chi Minh City will be added to a list of airports connected with Okinawa's logistics hub. ANA and Okinawa prefecture initiated the Okinawa International Aerial Logistics Hub Project in October 2009, which utilizes 24/7-operating cargo facilities in Naha airport, Okinawa (Figure 6). It now connects with Seoul, Shanghai, Taipei, Hong Kong, and Bangkok, as well as Narita, Haneda, and Kansai airports. Our scenario invites Sendai and Tan Son Nhat airports into the project. Second, we reduce the time and costs of cargo handling in Osaka, Fukuoka, and Ho Chi Minh/Cai Mep seaports to stimulate a trunk sea route to Hong Kong and Singapore.

We set the scenario as follows:

Scenario 1: MIEC and Link Enhancement with Japan

After a 3-year recovery period, a new bridge over the Mekong River at Neak Loueng in Cambodia is constructed. Dawei and Kanchanburi are connected by a road, and border crossing facilitation along MIEC is introduced in Dawei/Kanchanburi (Myanmar/Thailand), Aranyaprathet/ Poipet (Thailand/Cambodia), and Bavet/Moc Bai (Cambodia/Vietnam). Dawei and Madras (India) are connected via a sea route that is equivalent to other routes between internationally equally important ports. Air routes between Okinawa and Sendai and between Okinawa and Ho Chi Minh are enhanced, and a more efficient sea route is developed for shipping among Osaka, Fukuoka, Hong Kong, Ho Chi Minh, and Singapore.

(2) Reducing "policy and cultural barriers (PCBs)" in addition to Mekong-India Economic Corridor (MIEC) development and link enhancement with Japan

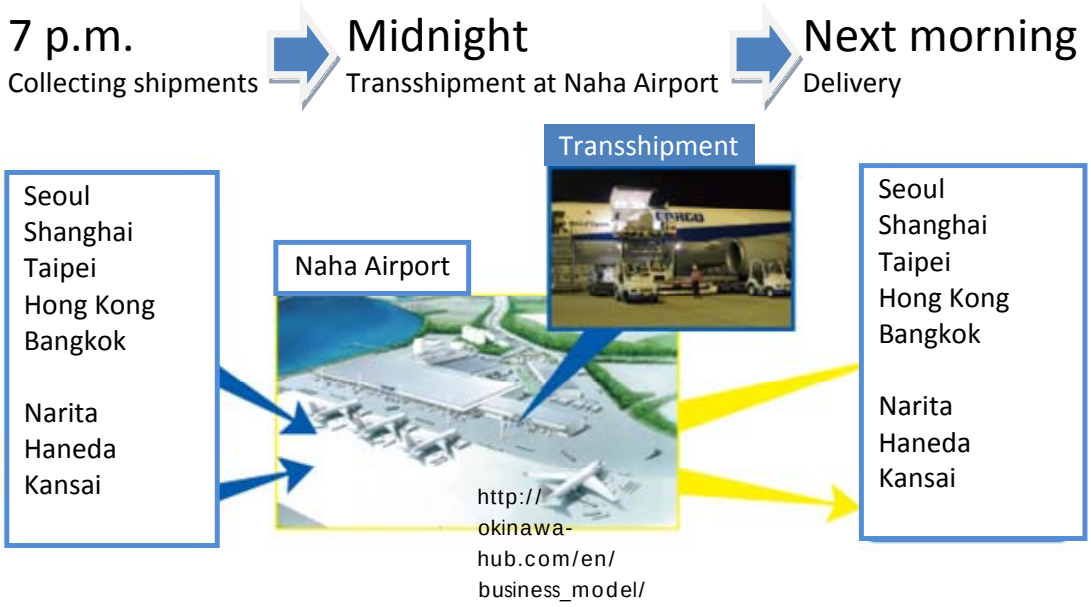
ERIA-GSM project in FY2010 reveals that policy and cultural barriers (PCBs) are high and such barriers inhibit smooth transactions in goods and services among countries (Kumagai *et al.* 2011). The project concludes that reduction in PCBs will have large positive economic impacts and extract the full potential of infrastructure development in East Asia.

To see the impact of PCB reduction, we set a scenario as follows:

Scenario 2: Reducing PCBs in addition to the other development and enhancement

After a 3-year recovery from the earthquake, countries involved in the MIEC, and Japan, reduce PCBs by 2% per year, in addition to the other development and link enhancement mentioned above.

Figure 6. Concept of the Okinawa International Aerial Logistics Hub project



Source: Website of Okinawa prefecture
http://okinawahub.com/en/business_model/

Figure 7. Economic impacts of MIEC, link enhancement, and PCB reduction (Scenario 2 compared with the baseline, 2030)

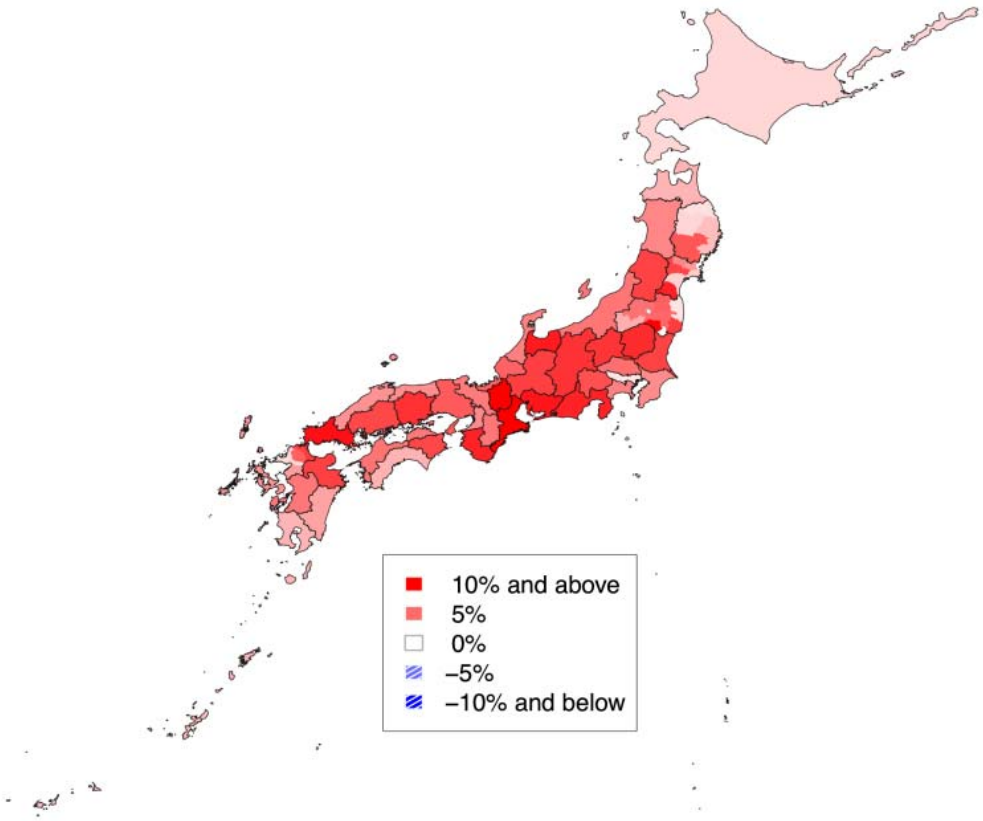


Figure 8. Economic impacts on selected prefectures and regions of MIEC, link enhancement, and PCB reduction (Scenarios 0, 1 and 2 compared with the baseline, 2030)

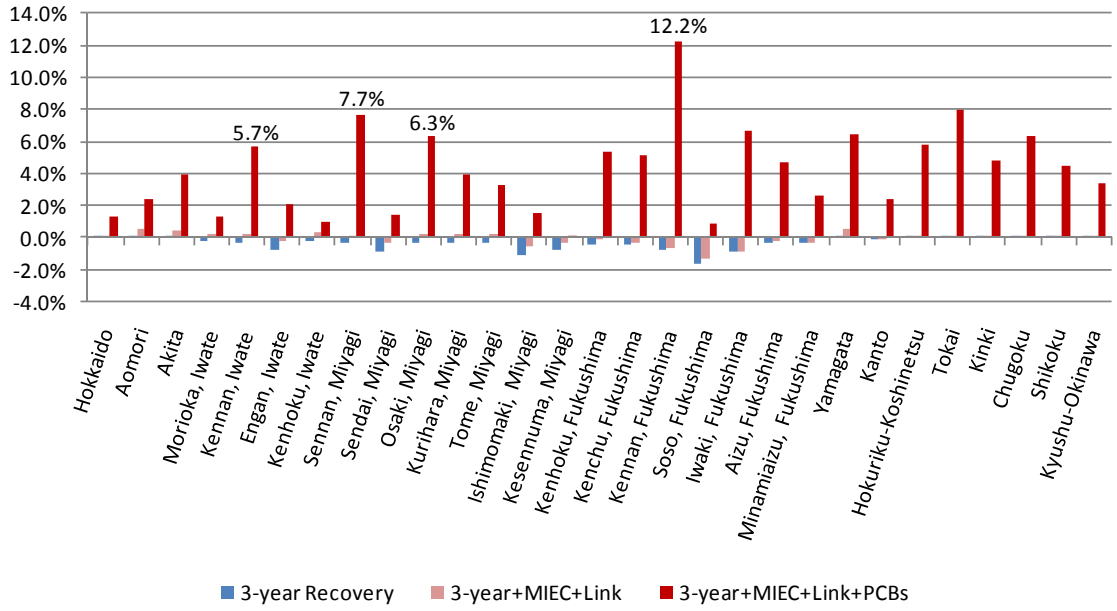


Figure 9. Economic impacts on selected countries and regions of MIEC, link enhancement, and PCB reduction (Scenario 2 compared with the baseline, 2030)

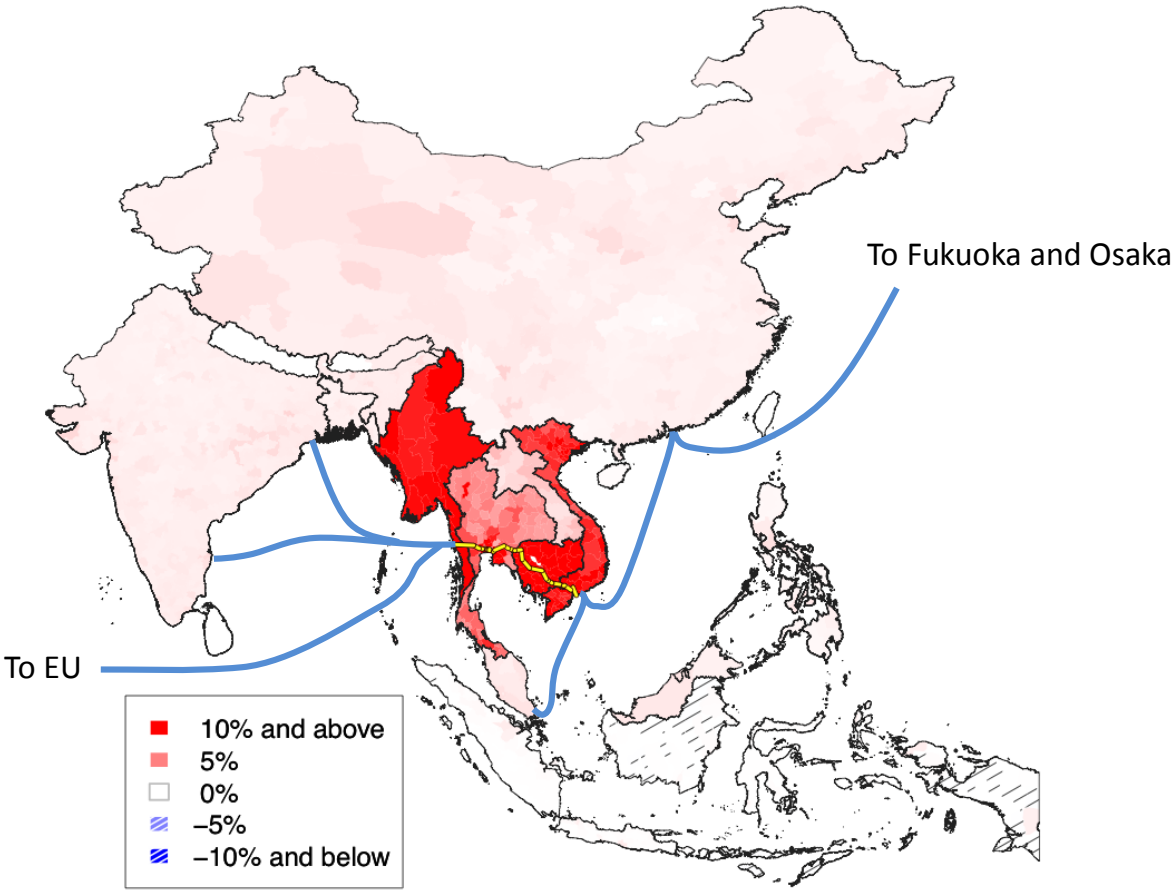
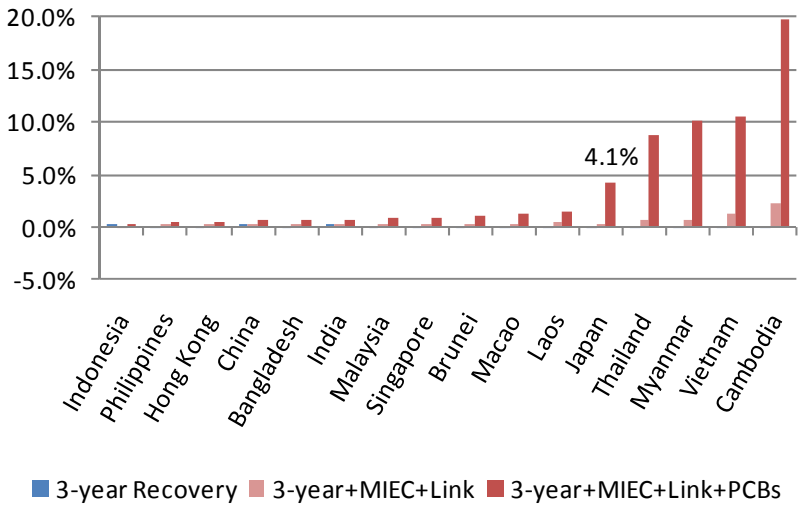


Figure 10. Economic impacts on selected countries of MIEC, link enhancement, and PCB reduction (Scenarios 0, 1 and 2 compared with the baseline, 2030)



(3) Simulation results for Scenarios 1 and 2

Figures 7 and 8 present the economic impacts on Japan. Compared with the baseline, Kennan-Iwate, Osaki-Miyagi, and Kennan-Fukushima will see positive impacts of 5.7%, 6.3%, and 12.2%, respectively, and other severely damaged areas can also move away from negative impacts in Scenario 2.

To reduce PCBs, steps must be taken to reduce the time for procedures before shipping, provide information in appropriate languages, enhance the capacity of medium-sized firms, and ensure transparency in dispute settlements.

Figure 9 shows economic impacts on East Asia in Scenario 2. Policies connecting regions and reducing PCBs will benefit most of the related countries and regions.

Finally, Figure 10 presents economic impacts on selected countries. MIEC development together with the link enhancement and PCB reduction will yield much higher economic impacts on MIEC countries, i.e., Cambodia, Vietnam, Myanmar, and Thailand than other scenarios.

4. Policy Implication

GSM claims that some serious negative impacts would remain in the Tohoku region and Japan as a whole if there were simply a recovery of infrastructure. This is because of the inevitable outflows of firms and households during the recovery process. The outflows would change the distribution of economic activities in the long run. There should thus be a swift recovery and the implementation of other supplementary policies at the same time.

We argue that link enhancement between Japan and East Asia would be a solution. The simulation results reveal that sea route enhancement would benefit mainly West Japan and air route enhancement would help the Tohoku region. In this regard, automobile and heavier auto parts would be suitable for West Japan while electronics parts and lighter auto parts would fit the Tohoku region.

Finally, we derive more policy implication from the IDE/ERIA-GSM exercise.

1. Some damage to society requires great effort to repair. We should not only rebuild physical

infrastructure but also conduct additional investment in human resource development and other economic/social infrastructure.

2. It is essential to enhance linkages between Japan and East Asia by reinforcing existing production networks. For Fukushima, Miyagi, and Iwate prefectures, tighter connection between Sendai Airport and Okinawa's logistics hub and other stimulus packages would be remedies.
3. Linkage enhancement between Asia and West Japan by sea networks would also benefit Japan and East Asia.
4. In addition, policy barriers need to be reduced.
5. Swift response is certainly important for a full recovery, and thus effective coordination among agencies is indispensable.

BOX 1: The importance of Dawei Port development in MIEC

Dawei Port must raise its capacity so that world-class container ships can use it.

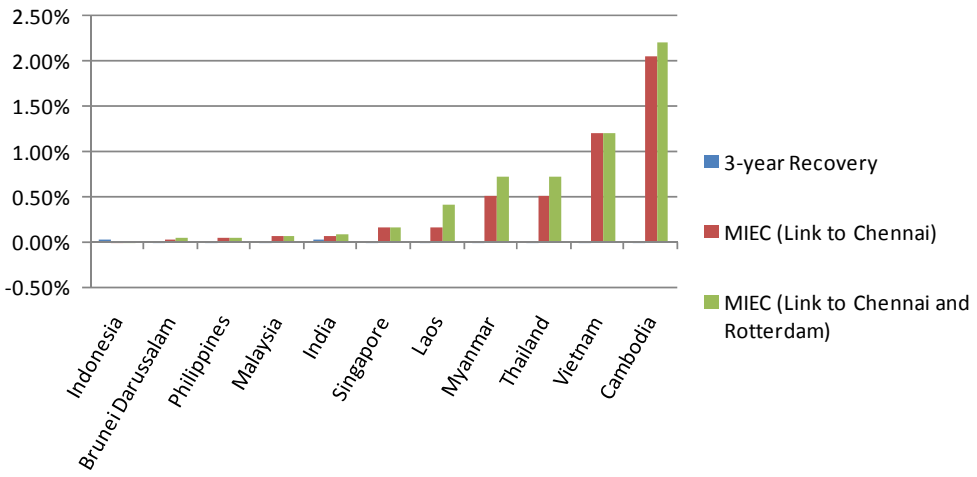
BOX Figure 1-1 compares three scenarios as follows:

(A) 3-year recovery: Recovery of infrastructure in three years after the earthquake.

(B) MIEC (Link to Chennai): After the earthquake MIEC is developed in connection only with Chennai.

(C) MIEC (Link to Chennai and Rotterdam): After the earthquake, MIEC is developed in connection with Chennai and Rotterdam, a main port of EU.

Box Figure 1-1: Economic Impacts of MIEC, changing connected ports (compared with the baseline, 2030)



By connecting Dawei Port to Rotterdam in addition to Chennai, positive economic impacts on Myanmar and Thailand will go up from 0.51% to 0.71% and from 0.52% to 0.72%, respectively. In particular, the link will benefit automotive manufacturers on the Eastern Seaboard in Thailand and garment industries in Cambodia, Laos, and Myanmar.

BOX 2: The importance of customs facilitation at the Dawei-Kanchanaburi border in MIEC

Trade and transport facilitation at Dawei-Kanchanaburi border will be crucial for MIEC.

BOX Figure 2-1 evaluates four different scenarios as follows:

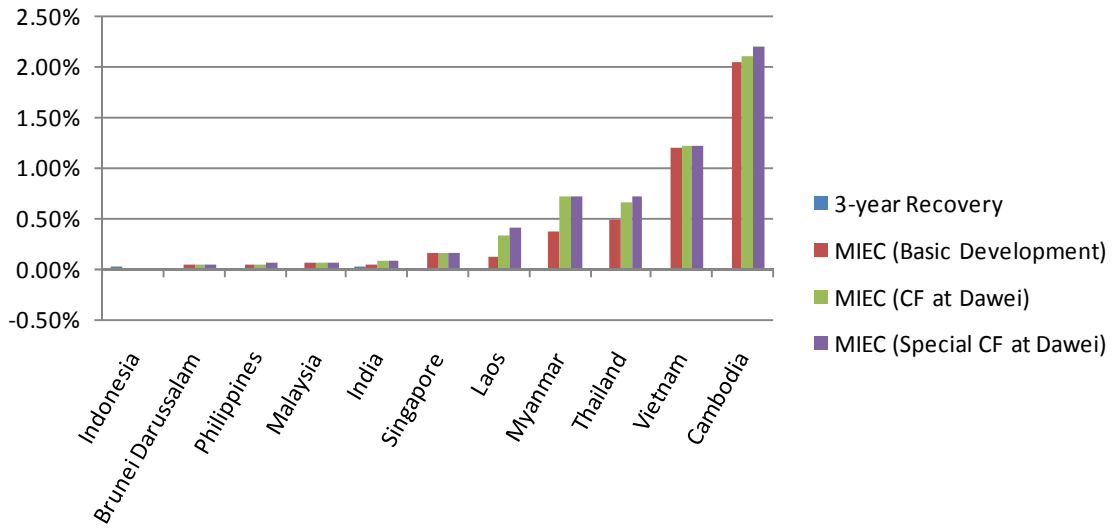
(A) 3-year recovery: Infrastructure recovers in three years after the earthquake.

(B) MIEC (Basic Development): After a 3-year recovery, a new bridge over the Mekong River at Neak Loueng in Cambodia is constructed. Dawei and Kanchanburi province in Thailand are connected by a road, and border crossing facilitation along MIEC is introduced at Aranyaprathet/Poipet (Thailand/Cambodia) and Bavet/Moc Bai (Cambodia/Vietnam), but there is no customs facilitation at Dawei/Kanchanburi (Myanmar/Thailand) border. Dawei and Chennai (India) are connected via a sea route that is equivalent to other routes connecting internationally important ports. Other links between East Asia and Japan are also improved.

(C) MIEC (CF at Dawei): In addition to (B), customs facilitation (CF) is introduced at the Dawei/Kanchanburi border to facilitate transactions between Thailand and Myanmar via the Dawei/Kanchanburi border.

(D) MIEC (Special CF at Dawei): In addition to (C), we shorten the transaction time and cost at Dawei/Kanchanburi border for transit trade from Thailand, Laos, Cambodia, or other ASEAN countries to India or EU and the other way round through Dawei Port.

Box Figure 2-1: Economic Impacts of MIEC, changing the level of customs facilitation at the Dawei-Kanchanaburi border (compared with the baseline, 2030)



Normal customs facilitation at the Dawei-Kanchanaburi border mainly raises the economic impacts in Laos, Myanmar, Thailand, and Cambodia. In addition, by offering special customs facilitation at the Dawei-Kanchanaburi border for transit trade from/to Thailand, Laos, Cambodia, and other ASEAN countries to/from India and the EU via Dawei port, positive economic impacts on Laos, Thailand, and Cambodia will increase from 0.33% to 0.41%, from 0.66% to 0.72% and from 2.10% to 2.20%, respectively. By introducing additional customs facilitation, firms in Thailand and Laos could utilize both Laem Chabang Port and Dawei Port for different trading customers and suppliers.

[1] As of June 21, 2011, reported by the National Police Agency.

[2] As of June 16, 2011, reported by the Cabinet Office.

[3] We also would like to acknowledge gratefully that 139 countries/territories and 39 international organizations presented intention to offer various forms of help and 20 countries/ territories sent emergency rescue teams to Japan (*Nihon Keizai Shimbun*, March 31, 2011). Japan also received numerous assistance from private sector and NGOs all over the world.

[4] In these simulations, we do not take into account short-term negative effects, such as the monetary cost arising from direct losses of human life, buildings, and other infrastructure. Nor do we include any short-term positive impacts arising from increased demand for infrastructure recovery materials, equipment or labor.

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