

Chapter 5

Geographical Simulation Model Analyses on Economic Corridors

March 2008

This chapter should be cited as

Working Group for Developing Roadmap toward East Asian Economic Integration (2008), 'Geographical Simulation Model Analyses on Economic Corridors' in Soesastro, H. (ed.), *Developing Roadmap toward East Asian Economic Integration*, ERIA Research Project Report 2007-1-1, Chiba: IDE-JETRO, pp.42-54.

5. GEOGRAPHICAL SIMULATION MODEL ANALYSES ON ECONOMIC CORRIDORS

5.1. Cross border transportation

As discussed in the previous chapters, an increasing number of FTAs have been concluded in Asia. Further deepening of economic integration will enhance international trade and investment in this region. In addition to such institutional arrangements, physical construction of transport infrastructure has also made rapid progress, linking major cities within and across Asian countries (e.g., the economic corridors in the Great Mekong Subregion (GMS), the Delhi-Mumbai highway in India).

When service link costs are reduced substantially by the development of logistic networks and the deepening of economic integration, manufacturing firms in the region might be able to supply their products to more remote markets. Similarly, the same reduction of service link costs enables producers to procure their parts and components from the suppliers at more distant sites. Then firms can establish their production networks spread over a vast area, linking highly productive suppliers. As a consequence, industrial production in the region as a whole becomes more efficient, and this brings about larger growth opportunities to the integrated economy.

However, at the same time, such improvement of service links might lead industries to be more localized in limited districts that are eminently suitable for their production. In particular, when there are significant economies of scale in production, firms tend to agglomerate in a limited number of locations, leaving other regions vacant. This likely intensifies the disparities among countries within the integrated economy (e.g., CLMV vs. other countries) as well as among domestic regions in each country (e.g., coastal vs. inland regions in China). To obtain the full benefits of the improvement of service links, therefore, individual countries and regions/cities need to implement industrial development measures with a long-term view to promote agglomeration of core industries.

Taking these issues into account, ERIA attempts to investigate the effects of the improvement of service links (in physical and institutional aspects) accompanying the process of economic integration. In FY2007, particularly, we carried out qualitative

and quantitative analyses of the economic consequences of the economic corridors in GMS — how it improves the potential of surrounding countries and affects economic disparities among them. The following is an overview of the current state of the economic corridors and other trade facilitation programs in GMS, and a brief explanation of our quantitative analyses of their economic influences.

5.2. GMS economic corridors

5-2-1. GMS Economic Cooperation Program

With respect to the development of transport infrastructure in CLMV countries, the GMS Economic Cooperation Program has played an important role⁷. So far under the program, various development projects have been implemented in nine sectors: 1) transportation, 2) telecommunications, 3) energy, 4) environment, 5) human resource development (HRD), 6) trade, 7) investment, 8) tourism and 9) agriculture.

Of these sectors, the greatest emphasis has been placed on transportation, especially cross-border transport infrastructure (CBTI). In addition, in order to improve service links, cross-border transport agreements (CBTA) that reduce institutional trade barriers have been launched. Furthermore, in order to confer the benefits of transport infrastructure development even on remote villages, building industrial estates and promoting industrial development along the road, are planned. The “economic corridors” of the GMS Economic Cooperation Program have been designed to combining these three pillars (Table 5-1 and Figure 5-1).

Table 5-1: Progress of three economic corridors

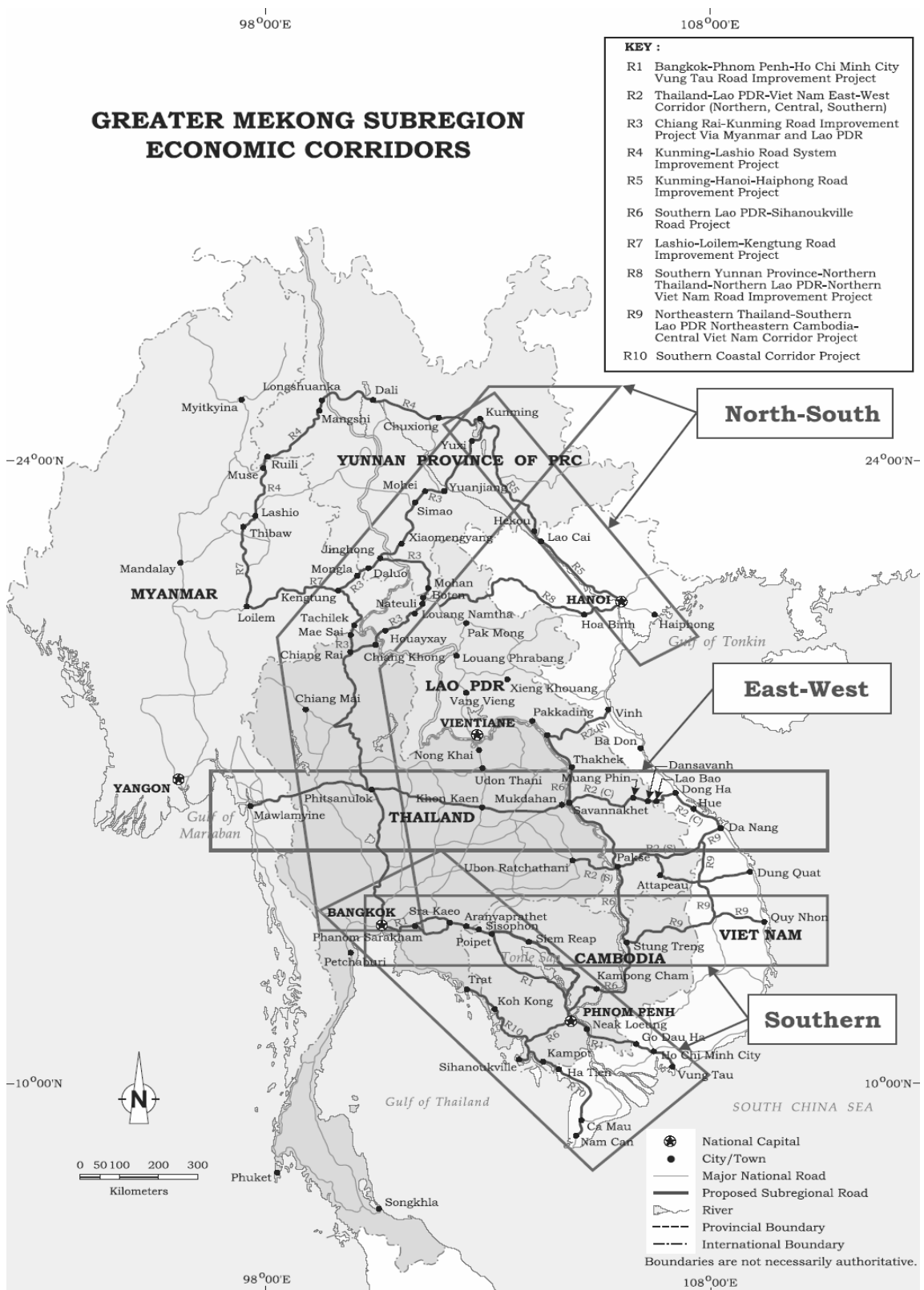
	CBTI	CBTA	Additional Measures
EWEC	Completed	Started to be realized ⁽¹⁾	Well-considered
NSEC	Not completed yet	Not yet agree	Considered, but not enough
SEC	Not completed yet	Already agreed	Well-considered

Note: (1) Concrete agreements have not yet been achieved between Thailand and Myanmar.

Source: Kumagai, *et al* (2008).

⁷ This Program was launched on the basis of an agreement at the ministerial meeting of five countries, Cambodia, Laos, Myanmar, Thailand, and Vietnam, and representatives of Yunnan Province of China in 1992, which was held on the initiative of Asian Development Bank (ADB).

Figure 5-1: Three economic corridors in the Greater Mekong Sub-region



Source: ADB (2002).

5.2.2. Three economic corridors

(1) East-West Economic Corridor (EWEC)

The EWEC is an economic corridor from Danang (Vietnam) to Mawlamyine (Myanmar) by way of Laos and Thailand. This route has been completed by building the Second Mekong International Bridge between Savannakhet (Laos) and Mukdahan (Thailand) in 2006. On the whole, the EWEC passes relatively poor area such as Laos, Myanmar, central Vietnam and northeastern Thailand. EWEC is expected to reduce development gaps in the region. With the completion of the bridge, logistics services connecting Bangkok and Hanoi by road have attracted quite a bit of attention from the business community. The government of Laos, however, expressed worries about the possibility that the part of Laos on EWEC is utilized just for transit by trucks between Bangkok and Hanoi. In order to benefit from EWEC, one special economic zone (SEZ) has been planned at Savannakhet. Another SEZ has already been developed at the border area of Lao Bao, Vietnam and several factories have already operated. At the border of Lao Bao (Vietnam) and Denhsavanh (Laos), customs clearance procedures have been unified at the importing country as a part of the CBTA that was signed between the two countries.

(2) North-South Economic Corridor (NSEC)

The NSEC comprises three routes. The first route connects Bangkok and Kunming (Yunnan); the second one is from Kunming to Haiphon (Vietnam) by way of Hanoi; and the third route goes from Hanoi to Nanning in Guangxi (China). The biggest city in Southern China, Guangzhou exists on the extended route⁸.

The first route is divided into a Myanmar route, a Laos Route and a shipping line on Mekong River from Jinghong (China) to Chiang Saen (Thailand). The three routes are connected to National Road No.1 of Thailand in Chiang Rai Province, and there are some plans to build industrial estates in the province. At present, most of goods traded between Thailand and China are conveyed by ships on Mekong River. On the other hand, the construction for paving the Laos route was completed in 2007, and the Mekong River Bridge between Chiang Khong (Thailand) and Huay Xai (Laos) is

⁸ In 2005, after Guangxi Zhuang Autonomous Region of China becoming a member of GMS Economic Cooperation Program, it was added to the NSEC.

planned to be completed in 2011. With the completion of the bridge, logistics services by road between China and Thailand are expected to increase. However, a CBTA among China, Thailand, Myanmar and Laos, has yet to be signed. On the whole, there are not many additional measures to support economic activities in rural areas and projects are concentrated on the transport infrastructure development.

(3) Southern Economic Corridor (SEC)

The SEC is composed of three routes. The first route is the Central Sub-corridor which connects Bangkok (Thailand), Phnom Penh (Cambodia), Ho Chi Minh City and Vung Tau (Vietnam). The second route is the Southern Coastal Sub-corridor and it goes along the coastal area from Bangkok to Camau (Vietnam), by way of Thailand's Eastern-Seaboard and Koh Kong and Sihanoukville (Cambodia). The third route is the Northern Sub-corridor, which connects Siemreap (Cambodia) and Quy Nhon (Vietnam). Among the three sub-corridors, the central sub-corridor, which connects two capital cities of Thailand and Cambodia, and the biggest city in Vietnam, is expected to lead to enhanced road transport logistics services between Ho Chi Minh City and Bangkok.

However, the government of Cambodia has concerns that the Cambodian part of the SEC's Central sub-corridor might be utilized only for transit by trucks between Bangkok and Ho Chi Minh City, which is similar to the concerns of Laos about the EWEC. To address these concerns, industrial estates have been planned at the border areas of Poipet, Koh Kong and Bavet. Among these industrial estate projects, several factories have been already operated in Bavet SEZ, while other border areas have not yet born fruit. In addition, CBTAs were already achieved between Vietnam and Cambodia and between Cambodia and Thailand. At present, the construction of Mekong River Bridge at Neak Loeng is expected to be started and the road between Poipet and Sisophon in Cambodia will be paved soon.

5.3. Geographical model simulation on economic corridors

As mentioned in section 5.1, the development of various types of infrastructure, especially transport infrastructure, might change the location of the industrial agglomeration in East Asia drastically in the long run through the reduction of service link costs. However, the exact impacts of the specific infrastructure development on

the location of the agglomeration are quite hard to predict, because the agglomeration of industry is a result of complicated interaction of agglomeration and dispersion forces.

One possible solution is to build a computer simulation model based on the New Economic Geography and actually calculate these complicated interactions of agglomeration and dispersion forces along various scenarios. In an ERIA research project, we are developing the Geographical Simulation Model for IDE/ERIA Infrastructure Project (IDE/ERIA-GSM) predicting the long-run impacts of various transport infrastructure developments on the location of the industrial agglomeration (Kumagai, *et al*, 2008).

5.3.1. Geographical simulation model based on New Economic Geography

Here, we present the outlines of the IDE/ERIA-GSM. The IDE/ERIA-GSM covers the Continental South East Asia (CSEA),” which comprises 10 countries/regions, namely, the CLMV countries, Thailand, Malaysia, Singapore, and Yunnan (China), Bangladesh, and India. The IDE/ERIA-GSM is a gravity model which signifies geographical distances and economic size. The IDE/ERIA-GSM model is unique in several aspects. First, the model converts geographical distances between cities into truck driving time. This makes it possible to analyze the effect of simplification of custom procedures because the procedures can be measured in time. Second, the model is a city/sub-region model. It covers a total of 324 sub-national regions of GDP by sector (primary, secondary and tertiary industries), employees by sector (primary, secondary and tertiary industries), longitude and latitude, and area of arable land. The model includes 486 major cities and 613 links that are mainly based on the Asian Highway networks cities. Third, the regional data and the routes data between cities are compatible. For instance, all the cities on the routes data are appeared on the regional data, with other attributions of the city (region), especially, latitude and longitude. However, most regions of China (excluding Yunnan) and the rest of the world are not included in the current model.

The idea of the IDE/ERIA-GSM comes from the model developed by Fujita, Krugman and Venables (1999)⁹, Fujita, Krugman and Mori (1999), and Midelfart-Knarvik, *et al* (2001 and 2002), which explicitly incorporates transportation

⁹ See Chapter 6, in particular.

costs or service link costs. In the model, a city having good access to the other cities tends to increase in population, because 1) the city can sell the goods to other cities at lower price due to low service link costs, and 2) the city can buy the goods from other cities at lower cost. As a result, firms in the city can generate increased profits, and can employ labor at higher wage rates. The labor force, therefore, would move from the city in which the real wage is lower to the city in which the real wage is higher. The IDE/ERIA-GSM calculates the dynamics of the population, or the movement of labor, based on the differences in the real wages between countries/ regions/ industries. The IDE/ERIA-GSM is able to set the speed of adjustment differently for inter-country/ inter-region/ inter-industry labor movement.

5.3.2. *Maintained assumptions*

We set several macroeconomic and demographic parameters constant and change only logistic settings by scenario. We maintain the following macro parameters across the scenarios:

- GDP per capita of each country is assumed to increase by the average rate for the year 2000-2005, other things being equal¹⁰.
- National population of each country is assumed to increase by the rate forecast by UNFPA until year 2025.
- There is no immigration between CSEA and the rest of the world.

5.3.3. *Base-line scenario*

Base-line scenario set the following assumptions:

- The Asian Highway networks all exist and cars can run at 40km/h across the highway.
- The border costs, or the times required for customs clearances are as follows:

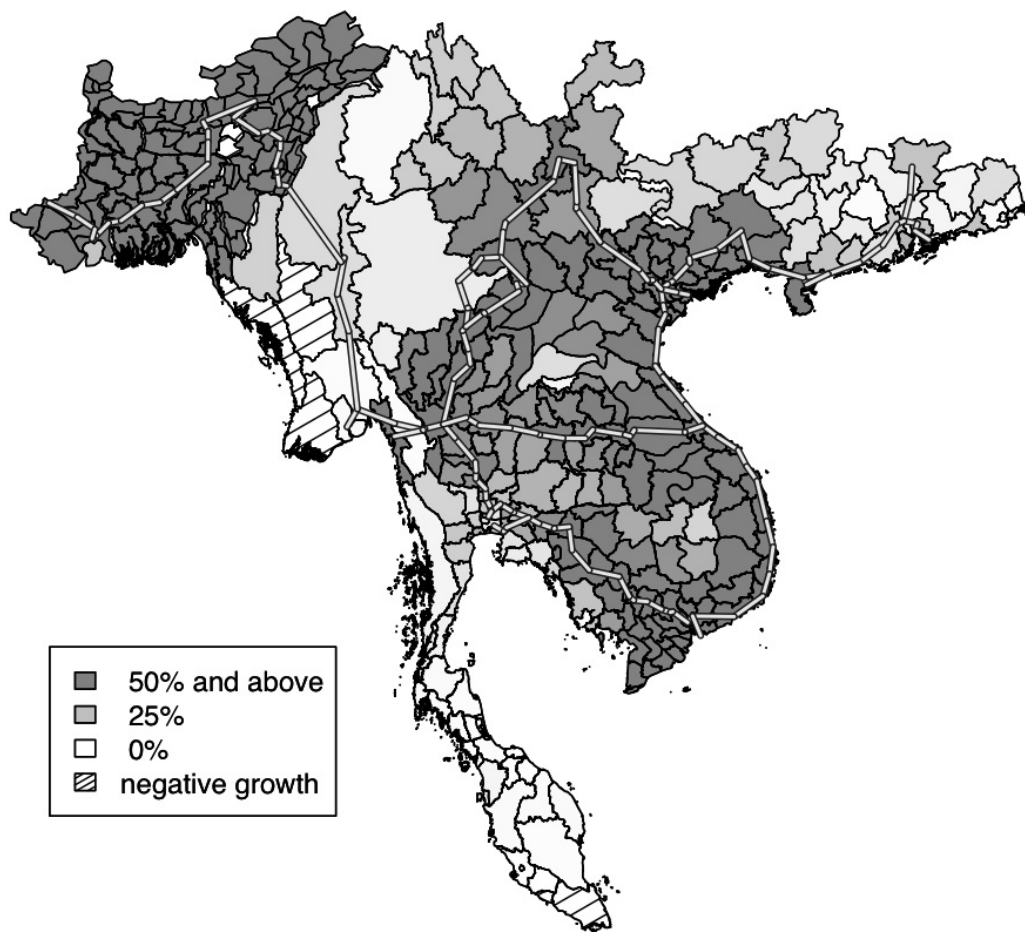
Singapore – Malaysia:	2.0 hours
Malaysia – Thailand:	8.0 hours
All other national borders:	24.0 hours

¹⁰ The growth rate of GDP per capita in each city is likely to differ from the national average for a variety of reasons, and this was actually so in the simulation.

5.3.4. Fully developed economic corridor scenario and results

We set a scenario with the assumptions of the fully developed economic corridors, namely, East-West Economic Corridor (EWEC), North-South Economic Corridor, Southern Economic Corridor, and the Asia Highway No. 1. Trucks can drive on all the above routes at 80 km/h, and other highway at 40km/h. In addition, along these economic corridors, trucks can pass without any border control. Figure 5-2 shows the differences in GDP at 2025 between this and the baseline scenario. Many cities can enjoy large benefits from the fully developed economic corridors. A well-designed development plan would produce bright perspectives on the cities along the economic corridors and highways.

Figure 5-2: Economic corridor simulation



Source: Kumagai, *et al* (2008).

5.3.5. Effects of customs facilitation

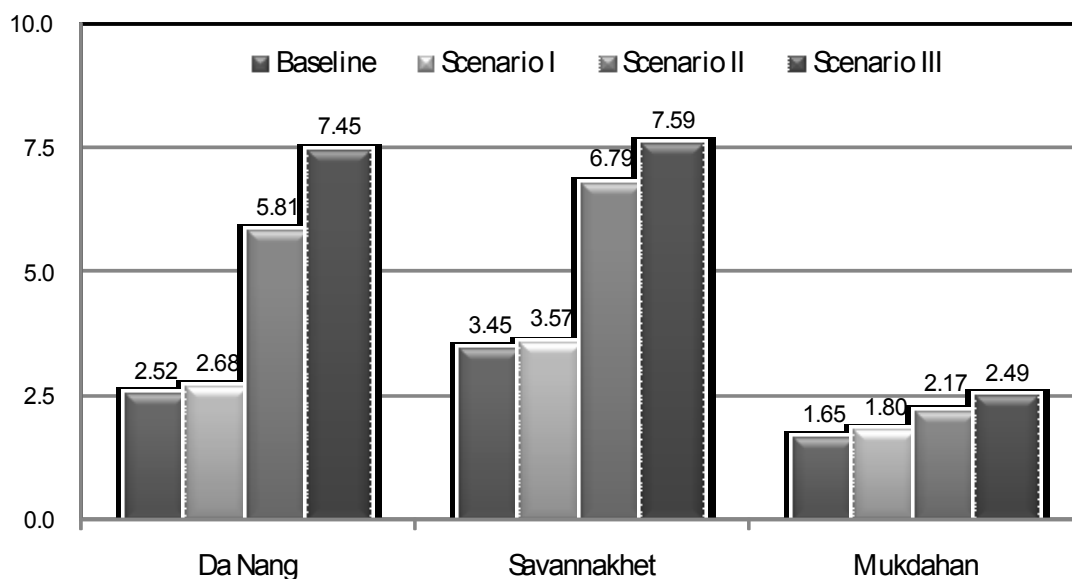
There are a number of border barriers in East Asia. Trade facilitation measures are expected to generate the large effect. In order to see the effect, two scenarios, that are, EWEC (physical infrastructure only) and EWEC (customs facilitation at borders only) are simulated. In the scenario I, trucks can drive at 80km/h on the EWEC but 40km/h on other road. In the scenario II, trucks drive at 40km/h on all the routes, and can pass the EWEC borders without any waiting time. In the scenario III, truck can drive 80km/h on the EWEC and pass the border without any border controls (Table 5-2). The simulation obtained the results that custom facilitation at border has a large effect (Figure 5-3). The simulation results imply that custom facilitation measures are quite important for the development of rural cities.

Table 5-2: Main assumptions for simulation analyses

Scenario		Speed on EWEC	Time required at EWEC borders
Baseline		40 km/h	24 hours
I	EWEC	80 km/h	24 hours
II	Facilitation	40 km/h	0 hour
III	EWEC+ Facilitation	80 km/h	0 hour

Source: Kumagai, *et al* (2008).

Figure 5-3: Gains in GDP by Scenario for Selected Regions (2025) from EWEC



Source: Kumagai, *et al* (2008).

5.4. Implication of the geographical model simulation results

There is a strong suspicion that only Bangkok and Hanoi benefit from the EWEC but other cities do not. The preliminary simulation results clear up such concerns. The development of EWEC “might” greatly change the geographical distribution of population and agglomeration of industry and significantly benefits the cities along it, as cities along the EWEC are expected to attract population and industry. On the other hand, the cities along the better transport infrastructure are not necessarily going to benefit from it. This means, the development of transport infrastructure will give grade effect on population and industry in the region.

The NSEC benefits northern Vietnam, northern Laos and southern Yunnan province. On the other hand, SEC benefits most of the regions in Cambodia and southern Vietnam. The economic corridors of EWEC, NSEC and SEC seem to be highly complementary projects. Assuming all the economic corridors are developed together, most of the regions in the Greater Mekong Subregion (GMS), except for Myanmar, will benefit.

The North-South Economic Corridor has promoted the traditional type of trade in

which Laos, Myanmar and Thailand export agricultural products to China, and China exports manufactured products to those ASEAN countries. In contrast, the East-West Economic Corridor, which has not performed well until now, is expected to agglomerate manufacturing industry within continental Southeast Asian countries, and promote the new type of trade in which the continental countries export parts and components each other.

To actually realize the estimated results, service link costs must be reduced by the reduction of the border barriers such as the streamlining of customs procedures (the ASEAN Single Window and possibly its extension to an East Asian wide single window system), efficient transportation, financial and insurance services (liberalization of trade in services such as transportation, finance, insurance, professional services related to transportation and logistics services). Also, network set-up costs are to be reduced by the establishment of industrial estates and investor friendly services by central and local government, which will enable investors to calculate costs and time for start-up businesses. In this regard, the special economic zones (SEZs), where those infrastructure and services can be well organized, are to be established.

5.5. Infrastructure development in island nations

The continental Southeast Asian countries can clearly benefit from the economic corridors. Southeast Asia's island countries (Brunei, Indonesia, the Philippines, and some parts of Malaysia), on the other hand, cannot get direct benefits like the continent countries. To grow together with the continental countries, the island countries need to reduce service link costs through comprehensive trade facilitation measures as well as through infrastructure development, such as inland road networks and sea and air port facilities that will better link it to the continental Southeast Asian countries.

The island Southeast Asian countries are themselves undertaking comprehensive liberalization of its transportation sectors through the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) initiative. They are currently studying the "corridor concept" as a strategy for accelerating the development of a sub-regional multimodal transport connectivity and for enhancing cross-border trade, tourism, and investment within the sub-region. The success of these corridor concepts will leverage on existing and ongoing initiatives such as

enhancement of transportation connectivity through the expansion of air linkages, interstate mobility of buses and coaches and promotion of sea transport and linkages.

5.6. Special economic zones

The forces of agglomeration and fragmentation have generated production-condition-oriented industrial location and have constructed sophisticated international production and distribution networks in East Asia. As associated with economies of scale in production, fragmented production blocks tend to concentrate in a limited number of locations with low service link costs that also tend to enjoy scale merits.

As a consequence, some countries, regions and cities may attract more and more firms and population; others may be left vacant. To obtain the full benefits of economic integration in East Asia, individual countries, regions and cities need to launch industrial development measures to promote industrial clusters, as mentioned in section 5.1.

Special economic zones (SEZs) have been widely established in East Asia and have proven to be an effective program for industrial development. Export-oriented industries that had led the East Asian developing economies are typically located in export processing zones (EPZs), a major functional type of SEZs. SEZs may also include free trade zones (FTZs), general industrial zones (GIZs) and industry-specific zones such as electronics, garment, financial and even tourism.

SEZs are designed to insulate themselves from the rest of the economies, where business and investment climate are often unfavorable to investors, foreign ones in particular. SEZs, EPZs in particular, are enclaves that are treated as being outside the customs territory of the host state, where export-oriented activities are undertaken, and such activities benefit from a favorable tax regime and the exemption of duties. SEZs are also provided with better infrastructure services, e.g. transportation, telecommunication and energy. It is much easier for the government of a host country to intensively construct infrastructure that is exclusively for use in enclave SEZs rather than develop a nation-wide infrastructure of the same caliber.

Firms located in SEZs, thus, enjoy improved business and investment climate at lower service link costs for the connection with other fragmented production blocks and

markets in East Asia. It could be an effective industrial development strategy to establish SEZs in cities identified by ERIA's simulation (described in 5-3) as offering high potential.