Comparing the economic impacts of Asian integration by computational simulation analysis

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Abstract

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Keywords: spatial economics, economic integration, ASEAN, simulation analysis

JEL classification: F15, O53, R12

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ABSTRACT

The Geographical Simulation Model developed by IDE-JETRO (IDE-GSM) is a computational simulation model based on spatial economics. IDE-GSM enables us to predict the economic impacts of various trade and transport facilitation measures. Here, we mainly compare the prioritized projects of the Master Plan on ASEAN Connectivity (MPAC) and the Comprehensive Asia Development Plan (CADP). MPAC focus on specific hard or soft infrastructure projects that connect one ASEAN member state to another while the CADP emphasizes the importance of economic corridors or linkages between a large cluster and another cluster. As compared with MPAC projects, the simulation analysis shows that CADP projects have much larger positive impacts on ASEAN countries.

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Introduction

After the remarkable progress in the theoretical aspect of spatial economics or the New Economic Geography (NEG) in the 1990s, some realistic simulation models have appeared in the 2000s, although these numerical simulations are rather minor (Fujita and Mori 2005:396–397). The Institute of Developing Economies (IDE), in coordination with the Economic Research Institute for ASEAN and East Asia (ERIA), has been developing the Geographical Simulation Model (IDE-GSM) since 2007, which is a unique numerical general equilibrium simulation model based on NEG. IDE-GSM enables numerical analyses of the impact of trade and transport facilitation measures (TTFMs) at the subnational level. Our model comprises seven sectors, including manufacturing and non-manufacturing sectors, and more than 1,800 regions in 18 countries/economies in East Asia. The East Asian countries/economies are Bangladesh, Brunei Darussalam, Cambodia, China, Hong Kong, India, Indonesia, Japan, Korea, Lao PDR, Macao, Myanmar, Malaysia, Philippines, Singapore, Taiwan, Thailand, and Vietnam.

There are two strands of research relating to NEG-based simulation models. The first evaluates the effects of a specific policy, mainly TTFMs, on the spatial structure of a regional economy.[1] Teixeira (2006) applies a NEG-based simulation model to evaluate the transport policy in Portugal and concludes that the development of transport networks has, so far, not contributed to the spatial equity in the region. Bosker et al. (2007) divide the European Union (EU) into 194 NUTS-II-level regions (Nomenclature of Territorial Units for Statistics) and simulate the effect of further integration of the EU using a model based on Puga (1999). They find that further integration leads to higher levels of agglomeration.

The second strand of research examines the validity of the NEG theory by comparing

[1] In research on the EU, several attempts have been made to simulate the effects of infrastructure development using the spatial CGE model, such as Bröcker et al. (2003).

the results generated by the simulations with actual data. For instance, Fingleton (2006) compares the validity of a NEG model and that of a model based on urban economics (UE) on the spatial wage structure in Great Britain and finds that, as a whole, the UE has more explanatory power than the NEG. On the other hand, by dividing the region into a 2,627 grid, Stelder (2005) tries to replicate the size and location of agglomerations in Europe by a NEG model. The author concludes that the model replicates the size and location of the agglomerations to a substantial degree. Bosker et al. (2007) also try to replicate the distribution of manufacturing labor in the EU and succeed fairly well.

The IDE-GSM is included in the first strand of research, although it has some differences from this strand. The first difference is that the IDE-GSM simulates the economic geography of East Asia, although many of the studies in this field focus on the EU or the United States as their area of study. There are very few NEG-based models for East Asia and none of them covers this large area. Second, as explained in the following sections, the IDE-GSM has very realistic transport networks and modal choices. These features give it a strong advantage when evaluating the effects of various TTFMs. Third, the IDE-GSM intends to evaluate the effects of infrastructure development *in the future*, not the past. This is because there is not enough time-series economic data for East Asia at the subnational level in order to evaluate past infrastructure-development projects.

The purpose of this paper is to illustrate the impact of various TTFMs on ASEAN member countries at the subnational level by utilizing the IDE-GSM. This paper is organized as follows. In Section 1, we present the simulation model. In Section 2, we provide our data sources and parameter values used in the simulation model. Section 3 explains how we calculate the economic impact of TTFMs, and then we present the results of our simulations for ASEAN TTFMs, mainly the MPAC and CADP. Finally, we conclude this paper in Section 4.

1. The Model

An NEG model, either theoretical or empirical, tends to be complex and hard to solve mathematically. So, NEG studies frequently use numerical simulations. The very basic model—the Core-Periphery (CP) model by Krugman (1991)—also uses numerical solutions to show the fundamental characteristics of the NEG model. The basic CP model is a two-locations, two-goods model that sets one good (typically, agricultural goods) as the *numeraire*, which is produced by a constant return-to-scale technology and incurs zero transport costs, whereas the other good is produced by an increasing return-to-scale technology (typically, manufacturing goods), which incurs positive transport costs.

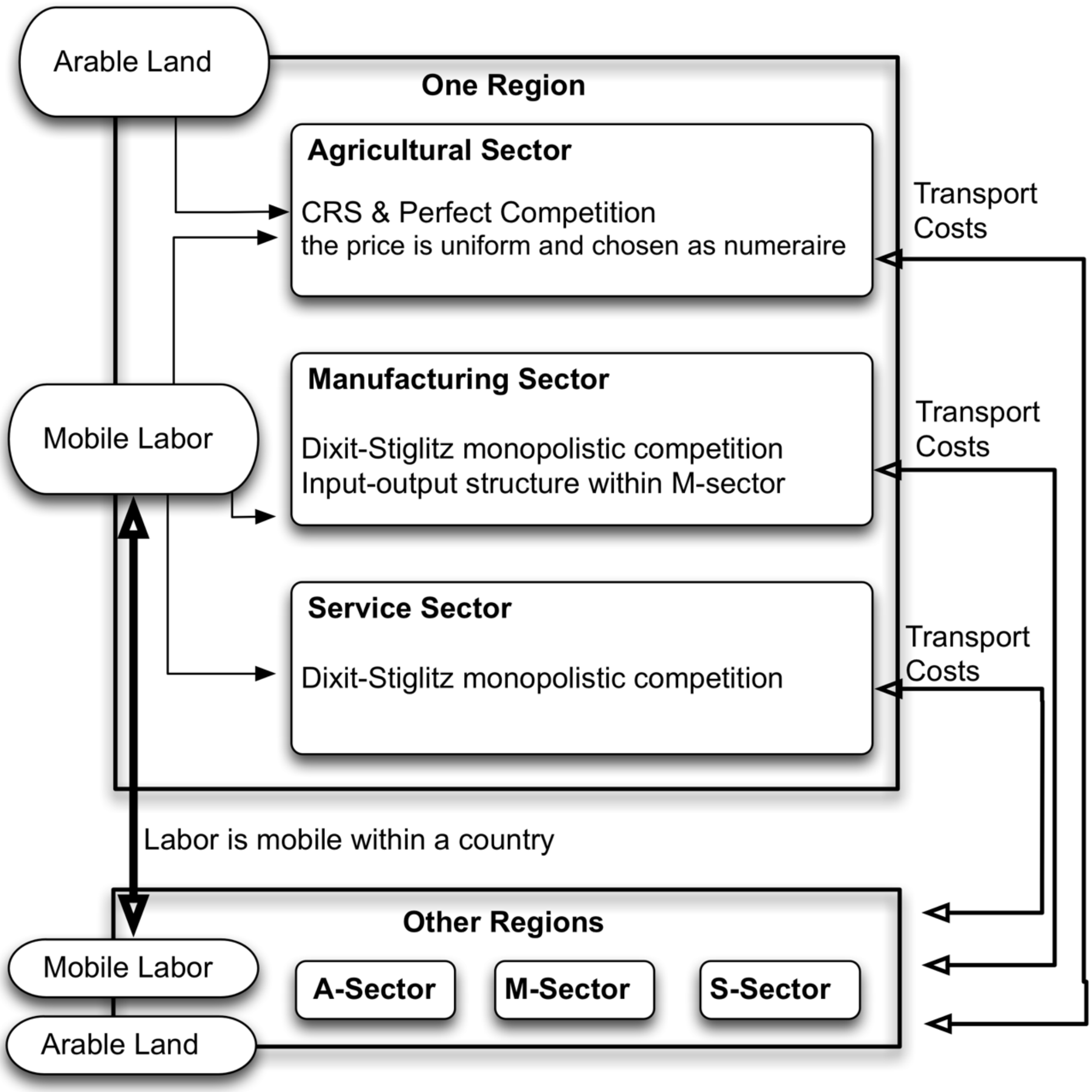
By manipulating the CP model, we can understand the basic behavior of a typical NEG model. For example, manufacturing activity tends to (1) diverge if the transport costs are very high or very low, (2) concentrate if the share of the income spent on manufacturing goods is large, and (3) concentrate if the elasticity of substitution is high, other things being equal.

The beauty of the CP model for many different locations is its simplicity, with many valuable implications applicable to a real-world setting. Indeed, the IDE-GSM, which started as a branch of the CP model with many locations, except that the geography is not a "race track" but a realistic network of cities.

The IDE-GSM was based on this CP model, with two main objectives: (1) to simulate the dynamics of the locations of the populations and industries in East Asia over the long-term, and (2) to analyze the impact of specific TTFMs on regional economies at the subnational level. In our simulation model, we include more than 1,800 regions. There are two endowments: labor and land. Labor is mobile within a country, but people are currently prohibited from migrating to other countries. Land is unevenly distributed in all regions and jointly owned by all of the labor in each region.

Figure 1 shows the structure of the model in the IDE-GSM. All products in the three sectors[2] are tradable. Transport costs are assumed to be of the "iceberg type," that is, if one unit of a product is sent from one region to another, a unit less than one arrives at its destination. The supplier sets a higher price, depending on the amount of loss in transit. The increase in price compared with the producer's price is regarded as the transport cost. Transport costs within the same region are considered negligible.

Figure 1: Structure of the Model



[2] In the actual model, the manufacturing sector is divided into five subsectors. So, the subscript *M* consists of M_1 to M_5. For simplicity, these subsectors are represented as a group by the "manufacturing" sector in this description.

Source: Authors.

Our simulation model determines the following regional variables: (1) nominal wage rates in three sectors; (2) land rent; (3) regional income; (4) regional expenditure on manufactured goods, price index of three sectors; (5) average real wage rates in three sectors; (6) population share of a location in a country; and (7) population shares of a sector in three industries within one location.

In the agriculture sector, we assume monopolistic competition with constant returns to scale technology and Armington assumption. The manufacturing and services sectors utilize the Dixit-Stiglitz type monopolistic competition with increasing returns to scale technology. We assume an input–output linkage in the manufacturing sector while no that linkage in the services sector.

Regional incomes in the model correspond to regional GDPs in our simulations. Suppose that revenues from land at location *r* belong to households at location *r*, GDP at location *r* is expressed as follows:

$$Y(r) = p_A(r)f_A(r) + w_M(r)L_M(r) + w_S(r)L_S(r)$$

where $p_A(r)$ is price of agricultural product derived from location *r* at location *r*, $f_A(r)$ is agricultural products at location *r*, $w_M(r)$ and $w_S(r)$ $\mathrm{w_S(r)}$ are nominal wage rates in the manufacturing sector and the services sector at location *r*, and $L_M(r)$ and $L_S(r)$ are labour input of the manufacturing sector and the services sector at location *r*, respectively.

The price indices of agricultural goods, manufactured goods, and services products at location *r* are expressed as follows:

$$G_A(r) = \left[\sum_{s=1}^{R} A_A(r)^{\sigma_A - 1} p_A(r)^{-(\sigma_A - 1)}\, T_{sr}^{A\,-(\sigma_A - 1)}\right]^{\frac{1}{-(\sigma_A - 1)}},$$

$$G_M(r) = \left[\sum_{s=1}^{R} L_M(s) A_M(r)^{\sigma_M - 1} w_M(s)^{(1-\sigma_M)\beta} G_M(s)^{-\sigma_M(1-\beta)} T_{rs}^{M\;-(\sigma_M - 1)}\right]^{\frac{1}{-(\sigma_M - 1)}}, \text{and}$$

$$G_S(r) = \left[\sum_{s=1}^{R} L_S(s) A_S(r)^{\sigma_S - 1} w_S(s)^{-(\sigma_S - 1)} T_{rs}^{S\;-(\sigma_S - 1)}\right]^{\frac{1}{-(\sigma_S - 1)}},$$

where

$$p_A(r) = \left[\mu_A \sum_{s=1}^{R} Y(s) G_A(s)^{\sigma_A - 1} T_{sr}^{A\;-(\sigma_A - 1)} / f_A(r)\right]^{\frac{1}{(\sigma_A - 1)}},$$

β is the input share of labour in producing manufacturing goods; μ_A is the consumption share of agricultural products; A_A, A_M, and A_S are productivity parameters for location *r*; T_{sr}^A, T_{rs}^M, and T_{rs}^S stand for the iceberg transport costs from location *r* to location *s*; and σ_A, σ_M, and σ_S are the elasticity of substitution between any two differentiated manufactured goods for agricultural, manufactured, and services goods, respectively. Nominal wages in the agricultural, manufacturing, and services sectors at location *r* are expressed as follows:

$$w_A(r) = \alpha A_A(r) \left(\frac{F(r)}{L_A(r)}\right)^{1-\alpha} p_A(r),$$

$$w_M(r) = \left[\frac{A_M(r) \beta^{\frac{1}{\sigma_M}} \left[\sum_{s=1}^{R} E(s) T_{rs}^{M\;1-\sigma_M} G_M(s)^{-(1-\sigma_M)}\right]^{\frac{1}{\sigma_M}}}{G_M(r)^{1-\beta}}\right]^{\frac{1}{\beta}}, \text{and}$$

$$w_S(r) = A_S(r) \left[\sum_{s=1}^{R} Y(r) T_{rs}^{S\;1-\sigma_S} G_S(s)^{-(1-\sigma_S)}\right]^{\frac{1}{\sigma_S}}.$$

The variables are decided using a given configuration of labor. Derived regional GDP, nominal wage rates, and price indexes are used to determine labor's decision on a working sector and place. The dynamics for labor to decide on a specific sector within a location is expressed as follows:

$$\dot{\lambda}_I(r) = \gamma_I \left(\frac{\omega_I(r)}{\overline{\omega}(r)} - 1 \right) \lambda_I(r), I \in \{A, M, S\},$$

where $\dot{\lambda}_I(r)$ is the change in labour (population) share for a sector within a location, γ_I is the parameter used to determine the speed of switching jobs within a location, $\omega_I(r)$ is the real wage rate of any sector at location *r*, $\overline{\omega}(r)$ is the average real wage rate at location *r*, and $\lambda_I(r)$ is the labour share for a sector in the location. The population share for a sector within a country is expressed as follows:

$$\lambda_I(r) = \frac{L_I(r)}{L_A(r) + L_M(r) + L_S(r)}.$$

where $L_A(r)$ is labor input of the agricultural sector at location *r*.

The dynamics of labor migration between regions is expressed as follows:

$$\dot{\lambda}_L(r) = \gamma_L \left(\frac{\omega(r)}{\overline{\omega}_C} - 1 \right) \lambda_L(r)$$

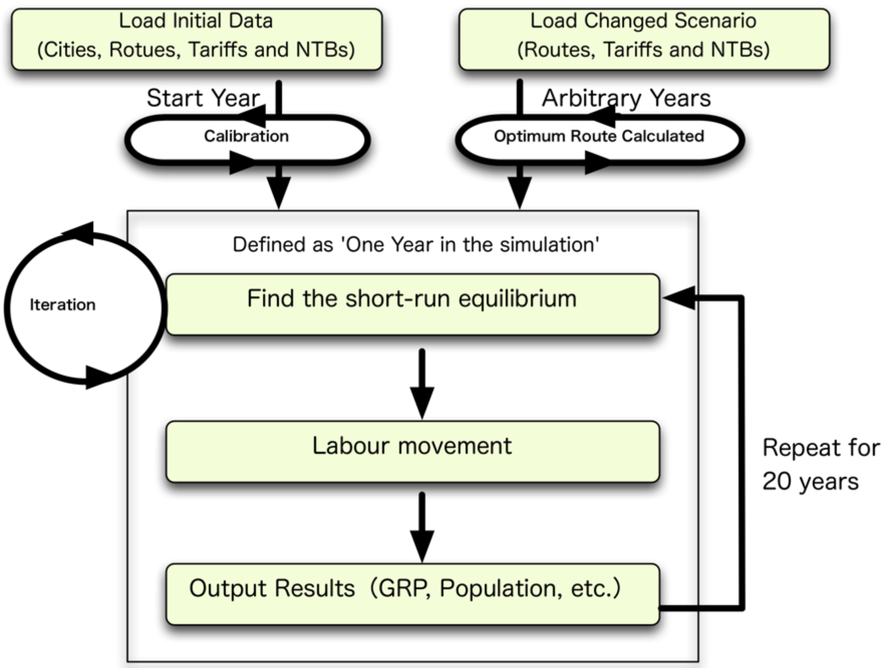
where $\dot{\lambda}_L(r)$ is the change in the labour (population) share of a location in a country, γ_L is the parameter for determining the speed of migration between locations, and $\lambda_L(r)$ is the population share of a location in a country. The symbol $\overline{\omega}_C$ shows the average real wage rate at location *r,* and $\omega(r)$ shows the real wage rate of a location and is specified as follows:

$$\omega(r) = \frac{Y(r)/\big(L_A(r) + L_M(r) + L_S(r)\big)}{G_A(r)^{\mu_A} G_M(r)^{\mu_M} G_S(r)^{\mu_S}}$$

where μ_M and μ_S show the consumption share of manufacturing and services, respectively.

The simulation procedures are shown in Figure 2. First, with given distributions of employment and regional GDP by sector and region, according to the actual data, we obtain the short-run equilibrium. Observing the achieved equilibrium, workers migrate among regions and industries, according to the differences in real wages. Workers move to the sectors that offer higher real wage rates within the same region and move to the regions that offer higher real wages within the same country. We subsequently obtain a new distribution of workers and economic activities. With this new distribution and predicted population growth, the next short-run equilibrium is obtained for the following year and we observe another migration. These computations are typically repeated for 20 years, ending in 2030.

Figure 2: Procedures of the Simulation



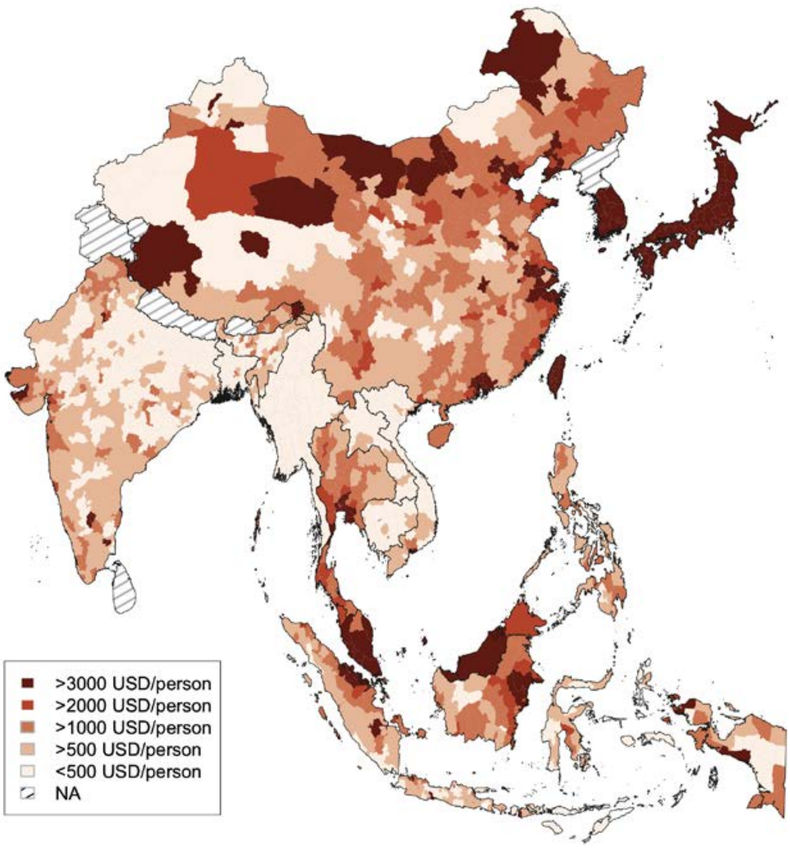
Source: Authors.

2. Data/Parameters

2.1 Economic Data

In the original CP model, there are two sectors, namely agriculture and manufacturing. To make the model more realistic, we divide the sector into several subsectors. The current version of the IDE-GSM has seven sectors. Primarily based on official statistics, we derive gross regional product (GRP) for the agriculture sector, five manufacturing sectors, and the service sector for 2005. The five manufacturing sectors are food processing, garments and textiles, electronics, automotive, and other manufacturing. Population and area of arable land for each region are compiled from official statistical sources. Figure 3 shows the GRP per capita for each region in 2005. In the simulation, we update this economic data for 2005 to 2010, according to the simulated distributions of intra-country GDP and actual macro-level GDP for each country in 2010. Then, we restart the simulation from 2010.

Figure 3: GRP per Capita in East Asia, 2005



source: Data compiled by the authors.

The administrative units adopted in the simulation are one level below the national level for Cambodia, Japan, Korea, Lao PDR, Malaysia, Philippines, Taiwan, Thailand, and Vietnam. For Bangladesh, China, India, Indonesia, and Myanmar, the administrative units are two levels below the national level. Brunei Darussalam, Hong Kong, Macao, and Singapore are treated as one unit, respectively. We also introduce more than 60 countries other than those in East Asia, although most of these countries lack a geographical dimension (i.e., the capital city represents the respective country).

Take, for example, the data construction for Malaysia. Malaysia is divided into 13 states and three federal territories at the primary level. We treat Putrajaya as a part of Selangor state, meaning there are 15 divisions in our dataset. The database for GRP by state and industry is the "National Accounts Gross Domestic Product by State 2005–2010," provided by the Department of Statistics (DOS), Malaysia. In these statistics, GDP is divided into ten sectors, although the manufacturing sector is treated as one sector. Therefore, we need to divide the manufacturing sector into five subsectors by utilizing the sectorial value-added data in the "Annual Survey of Manufacturing Industries 2005," aggregated for each state by the DOS.

The highest bar for developing a realistic NEG model in East Asia is not in the modeling itself but in the lack of reliable economic data at the subnational level. We usually need to divide the manufacturing GRP data into subsectors according to the shares of value added or output by industry, as calculated from the survey/census of manufacturing industries for that region. More precise regional economic and demographic data are needed at the subnational level in each country. In addition, the establishment of uniform territorial units for geographical statistics in East Asia is crucial. Without such uniform territorial units, various statistics cannot be compared directly across countries. For example, it is not proper to compare the concentrations of population at the "state" level in Malaysia versus those at the "provincial" level in China because more than half of Chinese provinces have a larger population than the country of Malaysia.

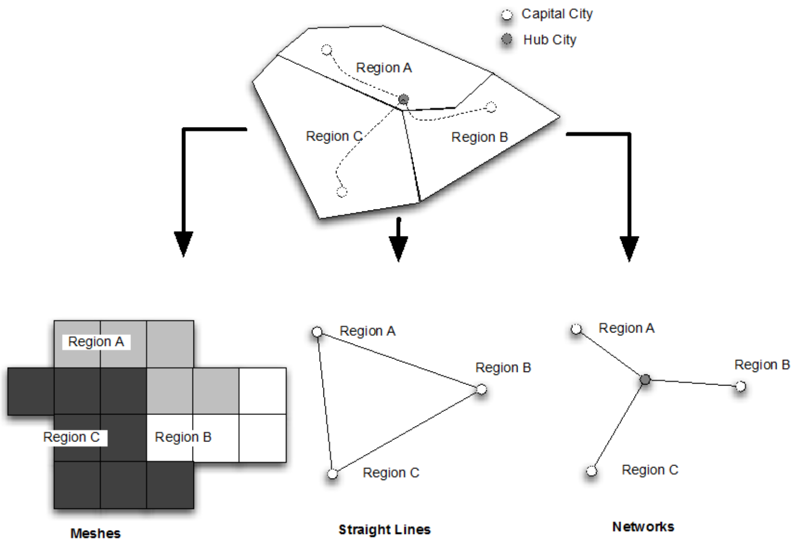
In Europe, EUROSTAT established the Nomenclature of Territorial Units for Statistics

(NUTS) more than 25 years ago. NUTS enables geographical analyses and the formation of regional policies based on a single uniform breakdown of territorial units for regional statistics. An East Asian counterpart of NUTS (perhaps called EA-NUTS) seems necessary as well. With EA-NUTS, basic social and economic information such as population, GRP, industrial structure, and employment by sector for each subregion could be collected and analyzed more efficiently.

2.2 Route Data

There are several ways to incorporate "geography" in an NEG model (Figure 4). The first one is the "mesh" or "grid" representation, in which a region consists of many meshes or grids. Each mesh is treated as a place of production and consumption that is connected to four or eight neighboring meshes. The second way is a "straight line" representation, which only connects cities as places of production and consumption by straight lines. There is no topology, and geography means the distances between cities. The third way, adopted by the IDE-GSM, is to incorporate geography as a "network" of cities[3] and routes.

Figure 4: Representations of Geography in NEG models



[3] The variable "city" used in the GSM refers to an administrative city. But the GSM does not exclude the possibility of defining "city" as a more realistic area according to actual economic activities.

Source: Authors.

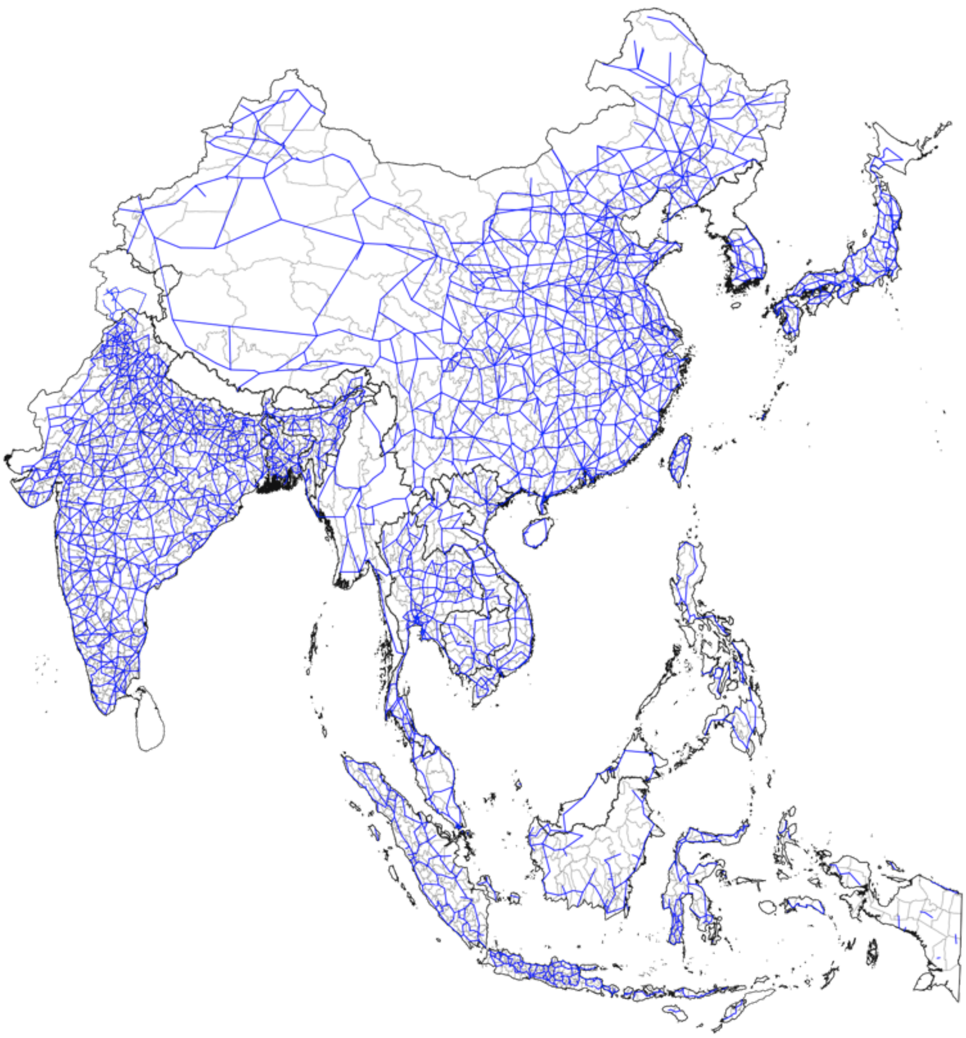
The “network” representation of geography has two major advantages over the mesh representation: First, it makes it possible to incorporate the realistic choice of routes in logistics; the mesh representation does not necessarily incorporate “routes” explicitly. A problem in topological representation is to calculate the minimal distance between any two cities considering every possible route between them. Fortunately, the Warshall-Floyd method provides a solution for this problem, and it is used in the IDE-GSM.

It is also possible to add a “hub city”, having no-population or industry, just to capture the realistic topology of cities and routes. It is also possible to put “border costs” explicitly at routes crossing the border, enabling the model to take into account various costs at border controls. Further, incorporating “routes” explicitly makes it possible to incorporate differences in the quality of a road by setting different “average speeds” for running on it. It is useful to evaluate the effects of TTFMs.

The number of routes included in the simulation is more than 10,000 (land: 6,500, sea: 950, air: 2,050 and railway: 450). The route data consists of start city, end city, distance between the cities, the speed of the vehicle running on the route, etc. The land routes between cities are based mainly on the “Asian Highway” database of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). The actual road distances between cities are used; if the road distances are not available, the distances between cities in a straight line are employed. Figure 5 shows the land route networks incorporated in IDE-GSM. The data on air and sea routes are compiled from Nihon Kaiun Shukaijo (1983) and the data set assembled by the team of the Logistics Institute - Asia Pacific (TLIAP), and 950 sea routes and 2,050 air routes are selectively included in the model. The railway data is adopted from various sources, such as maps and the official websites of railway companies.

To improve the reliability of the simulation analyses, it is crucial to have accurate data on the routes and infrastructures connecting regions in East Asia. Information on the main routes between regions such as physical distance, time distance, topology, and modes of transport (road, railway, sea, and air) is not easily obtainable. Data on "border costs" such as tariffs and time-costs due to inefficient customs clearance seem to be crucial, but they are also difficult to attain. In order to analyze the degree of regional integration, it may be necessary to measure and update the information on logistic conditions by conducting experimental distributions of goods.

Figure 5: Land Route Network Data in the IDE-GSM



Source: Authors.

2.3 Tariff/Non-Tariff Data

The sum of Tariffs and Non-Tariff Barriers (TNTBs) is estimated by employing the log odds ratio approach initiated by Head and Mayer (2000). We estimate industry-level TNTBs for 69 countries. TNTBs for the remaining sampled countries are obtained by prorating their TNTBs according to each country's per capita GDP. In evaluating these estimates for TNTBs, we need the elasticity of substitution—the sources of which are explained below.

Next, we obtain NTBs by subtracting tariff rates from the TNTBs. Our data source for tariff rates is the World Integrated Trade Solution, particularly TRAINS (Trade Analysis and Information System) raw data. For each trading pair, we aggregate the lowest tariff rates among all available tariff schemes at the tariff-line level into single tariff rates for each industry by taking a simple average. Available tariff schemes include multilateral free trade agreements (FTAs) (e.g., ASEAN + 1 FTA) and bilateral FTAs (e.g., the China–Singapore FTA), alongside other schemes such as the Generalized System of Preferences. Moreover, we somewhat take into account the gradual tariff elimination schedule in six ASEAN + 1 FTA, in addition to AFTA (ASEAN free trade area). We obtain information about whether each product finally attains a zero rate in ASEAN + 1 FTA from the FTA database developed in ERIA. We set the final rates for all products at zero in the case of AFTA owing to the lack of such information. As a result, we obtain separate (bilateral) tariff rates and (importer-specific) NTBs by industry on a tariff-equivalent basis. Finally, our total transport costs are the product of the sum of physical transport and time costs, and the sum of tariff rates and NTBs.

2.4 Parameters

The industry-related parameters are provided in Table 1. We mainly adopt the elasticity of substitution for the manufacturing sectors from Hummels (1999) and estimate it for services. Estimates for the elasticity of services are obtained from the estimation of the usual gravity equations for trade services, including such independent variables as the importer's GDP, the exporter's GDP, the importer's corporate tax, the geographical distance between countries, a dummy for FTAs, a linguistic commonality dummy, and a colonial dummy. For this estimation, we mainly employ data from the "Organisation for Economic Co-operation and Development Statistics on International Trade in Services."

Table 1: Industry Parameters

	Consumption Share	Labor Input Share	Elasticity of Substitution
Agriculture	0.04	0.61	-
Automotive	0.02	0.57	7.10
E&E	0.02	0.57	8.80
Textile	0.01	0.64	8.40
Food	0.03	0.61	5.10
Oth. Mfg.	0.16	0.59	5.30
Services	0.70	1.00	3.00

Source: Authors' calculations. Elasticity of substitution is mainly adopted from Hummels (1999).

The consumption share of consumers by industry is uniformly determined for the entire region in the model. It would be more realistic to change the share by country or region, but we cannot do so because we lack sufficiently reliable consumption data at a finer level of geographical unit. The single labor input share for each industry is uniformly applied throughout the entire region and time period in the model. Although it may differ among countries/regions and across time, we use an "average" value; in this case, the value for Thailand, which is a country in the middle-stage of economic development and whose value is taken from the Asian International Input-Output Table for 2005 by the IDE-JETRO. For the manufacturing sector data source, we use the survey conducted by the JETRO (2013).

The transport parameters are provided in Table 2. Our transport costs comprise the physical transport costs, time costs, tariff rates, and non-tariff barriers. Physical transport costs are a function of the distance traveled, travel speed per hour, physical travel cost per kilometer, and holding costs for domestic/international transshipments at border crossings, stations, ports, or airports. Time costs depend on travel distance, travel speed per hour, time cost per hour, and holding times for domestic/international transshipments at border crossings, stations, ports, or airports. These parameters are derived from the ASEAN Logistics Network Map 2008 by the JETRO and by estimating the model of the firm-level transport mode choice with the "Establishment Survey on Innovation and Production Network" (ERIA) for 2008 and 2009, which includes manufacturers in Indonesia, Philippines, Thailand, and Vietnam.

Table 2: Transport Parameters by Mode

	Truck	Rail	Sea	Air	
Cost/Km	1	0.5	0.24	45.2	US$/km
Avg. Speed	38.5	19.1	14.7	800	km/hour
Transit Time(Dom.)	0	2.7	3.3	2.2	Hours
Transit Time(Intl.)	13.2	13.2	15	12.8	Hours
Transit Cost(Dom.)	0	0	190	690	US$
Transit Cost(Intl.)	500	500	491	1276	US$

Source: Estimated by Authors.

On the basis of these parameters, we calculate the sum of physical transport and time costs for all possible routes between two regions. Employing the Floyd–Warshall algorithm for determining the optimal route and transport mode for each region and good (Cormen et al., 2001), we obtain the sum of physical transport and time costs for each pairing of two regions by industry.[4] The procedures to calculate these parameters are explained in Kumagai et al. (2013).

3. Application to ASEAN Integration

In this section, we propose four analyses on different TTFMs by the IDE-GSM. We take the differences of GDPs/GRPs between the baseline scenario and an alternative scenario

[4] The road network has been constructed not by the direct distance between cities but by approximated road links on maps. This represents a clear difference from equidistance analyses, such as Stelder (2005). In this sense, our method resembles that used in Bosker et al. (2010), who conduct a simulation analysis for the EU with realistic non-equidistances. Also, they show that the theoretical implications obtainable from the equidistant two-region model can be demonstrated by the non-equidistant multiregional model, which is the same framework as our analysis.

to calculate the economic impacts of TTFMs. The baseline scenario contains minimal additional infrastructure development after 2010. The alternative scenario contains specific TTFMs, in addition to all of the development in the baseline scenario. We compare the GDPs or GRPs between two scenarios in 2025 or 2030. If the GRP of a region in a scenario with specific TTFMs is higher (lower) than that in the baseline scenario, we regard this surplus (deficit) as the positive (negative) economic impacts of the TTFMs.

In the baseline scenario, we assume a kind of business-as-usual situation. The following assumptions are maintained in all scenarios, including the baseline case, even if they are not explicitly cited in a specific scenario:

- The national population of each country is assumed to increase at the rate forecast by the United Nations Population Division until 2030.
- International labor migration is prohibited.
- Tariffs, non-tariff barriers, and services barriers change on the basis of FTA/economic partnership agreements (EPAs) currently in effect and according to the phased-in tariff reduction schedule by the FTAs/EPAs and Hayakawa and Kimura (2015).

We give different exogenous growth rates for the technological parameters for each country to calibrate the GDP growth trend from 2010 to 2020, which is estimated and provided by the International Monetary Fund.

It should be noted that even if trade and transport facilitation measures negatively impact a region’s economy according to the simulation scenario, this does not necessarily mean that the region is worse off than the current situation. Most of the countries in East Asia are expected to grow faster in the next few decades, and the negative economic impacts offset a part of the gains from the expected economic growth. For any alternative scenario, we change the settings relating to the logistics infrastructure and/or other parameters pertaining to trade and production.

3.1 Dawei Deep Sea Port Development

The development of the Dawei Deep Sea Port is a joint initiative of the Myanmar and Thailand governments. The Dawei project consists of a deep sea port and the development of a special economic zone (SEZ), along with a petrochemical complex, in Dawei, Southern Myanmar, and a cross-border access road between Dawei and Bangkok. The project is supposed to facilitate access to the Andaman Sea and Indian Ocean from Thailand. In this “Dawei Port” scenario, we include the following TTFMs.

- New port development at Dawei, Myanmar, in 2020.
- Dawei is connected with three ports (Chennai, Kolkata, and Rotterdam) in 2020.
- Dawei and Kanchanaburi, Thailand, are connected by road in 2020.
- A bridge over the Mekong River at Neak Loeung has been constructed in 2015.

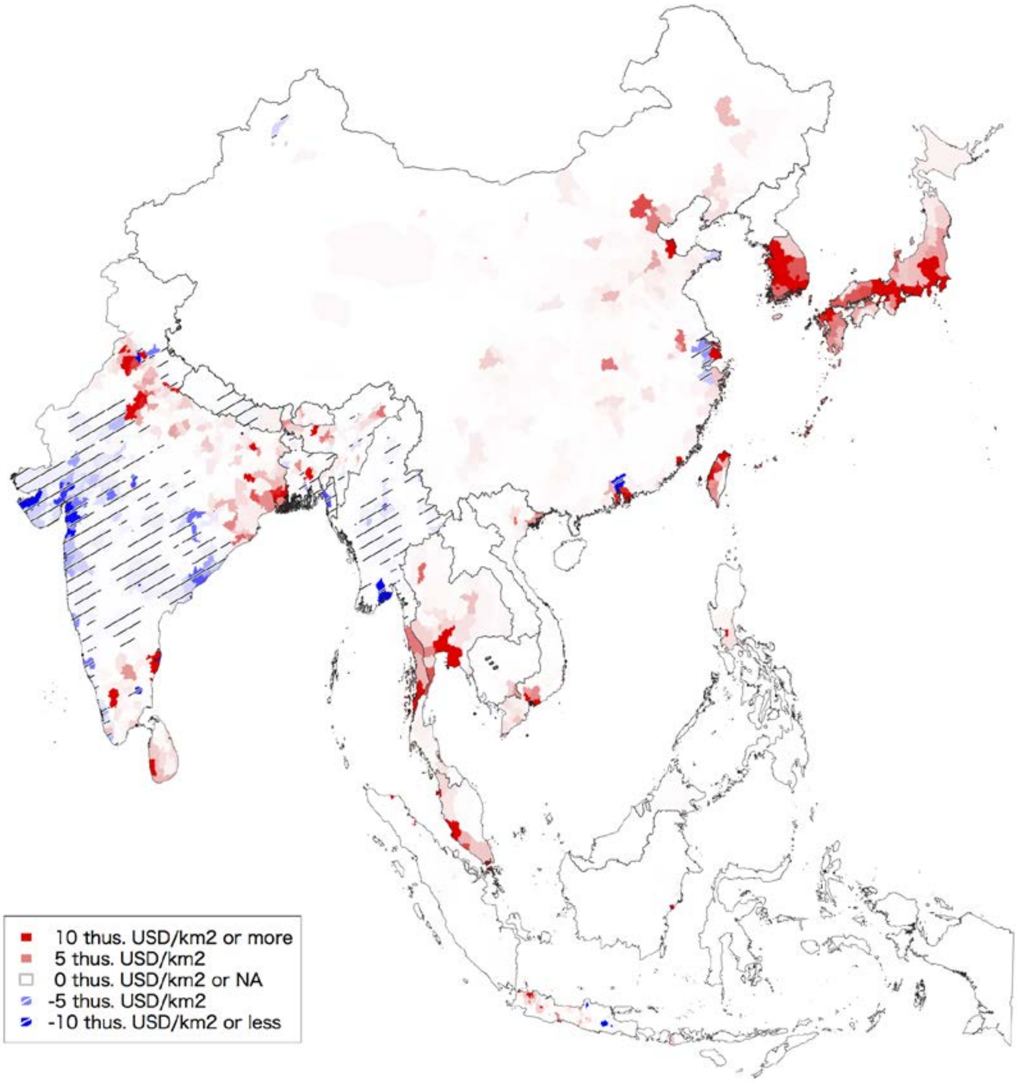
Table 3 shows the top five gainers in GRP of the Dawei project at the subnational level in 2030. Figure 6 shows the economic impacts of the Dawei Port Development in 2030, and the region that benefits the most from the project is Samut Prakarn, Thailand, followed by Bangkok, Thailand and Gautam Buddha Nagar, India.

Table 3: Top 5 Gainers by the Dawei Project, 2025 (USD Million)

Region	Country	Agriculture	Auto	E&E	Textile	Food	Oth. Mfg.	Services	GDP
Samut Prakarn	THA	0	145	5	139	239	146	10	684
Bangkok	THA	0	37	-1	173	228	108	82	626
Gautam Buddha Nagar	IND	1	113	170	44	15	104	61	509
Rayong	THA	0	33	0	167	207	85	8	500
Samut Sakhon	THA	0	107	4	97	165	107	6	486

Source: Calculated by IDE-GSM.

Figure 6: Economic Impacts of the Dawei Sea Port, 2025



Source: Simulated by IDE-GSM.

3.2 Kuala-Lumpur Singapore High Speed Rail (HSR)

The Kuala Lumpur (KL)–Singapore HSR is an entry point project to the Greater KL/Klang Valley, a National Key Economic Area (NKEA) under the Economic

Transformation Programme (ETP) by the Malaysian government. The HSR is planned to be built by 2020, and the agreement between the governments of Malaysia and Singapore was announced in February 2013. The railway stations currently specified include Kuala Lumpur, Seremban, Melaka, Muar, Batu Pahat, Nusajaya, and Singapore. The HSR will provide a travel time of 90 minutes between Kuala Lumpur and Singapore. In this "HSR" scenario, we include the following TTFMs in three different settings.

- HSR1: KL and Singapore are connected in 2020 by HSR via five intermediate stops, but the frequency is low (the average waiting time is 2 hours). There is a 30 minute wait at the border.
- HSR2: KL and Singapore are connected in 2020 by HSR via five intermediate stops, and the frequency is high (the average waiting time is 30–40 minutes). There is a 30 minute wait at the border.
- HSR3: HSR2 + Non-stop service and nil immigration-clearance time.

Table 4 shows the economic impacts of the HSR in 2030 by scenario and state. The states along the west coast of Malaysia and Singapore tend to gain from the HSR, whereas three states along the east coast lose some of their GDP, although the amount is small. The different wait frequencies of the HSR change the economic benefits significantly. In the low-frequency scenario (HSR1), the economic impacts are mostly concentrated in KL and Selangor, and Singapore loses some of its GDP.

This can be interpreted by the fact that the low-frequency HSR cannot substitute for the air traffic between KL and Singapore, but it can be used for domestic transport. Once the frequency of the HSR is high enough (HSR2), Johor becomes the greatest beneficiary of the HSR. The HSR seems to be mainly used between KL and Singapore, as well as between KL and Johor, and Johor and Singapore. The non-stop service and nil immigration-clearance time for the HSR passengers (HSR3) increases the total economic benefits by about 10%.

Table 4 Economic impacts of HSR by Scenario and by State, 2030 (USD Million)

	HSR1	HSR2	HSR3
Pahang	-5	-56	-46
Terengganu	-3	-34	-28
Kelantan	-1	-14	-16
Perlis	0	2	1
Pulau Pinang	2	11	6
Kedah	8	34	41
Melaka	3	-5	-28
Perak	5	32	35
N.Sembilan	3	31	39
Singapore	17	34	46
Selangor	25	160	166
KualaLumpur	43	243	253
Johor	48	1,203	1,240
Total	143	1,584	1,797

Source: Simulated by IDE-GSM.

3.3 All MPAC projects

MPAC projects include (1) upgrading Below Class III sections, (2) developing the Missing Links of the AHN, (3) developing Missing Links of Singapore–Kunming Rail Link (4) completing the framework agreements on transport facilitation in ASEAN, and (5) conducting studies on roll-on and roll-off (RoRo) ships. In this regard, we assume that all those upgrading and development are completed, trade facilitation is made at ASEAN land borders, and RoRo is introduced. The detail of the scenario is described in Appendix A.

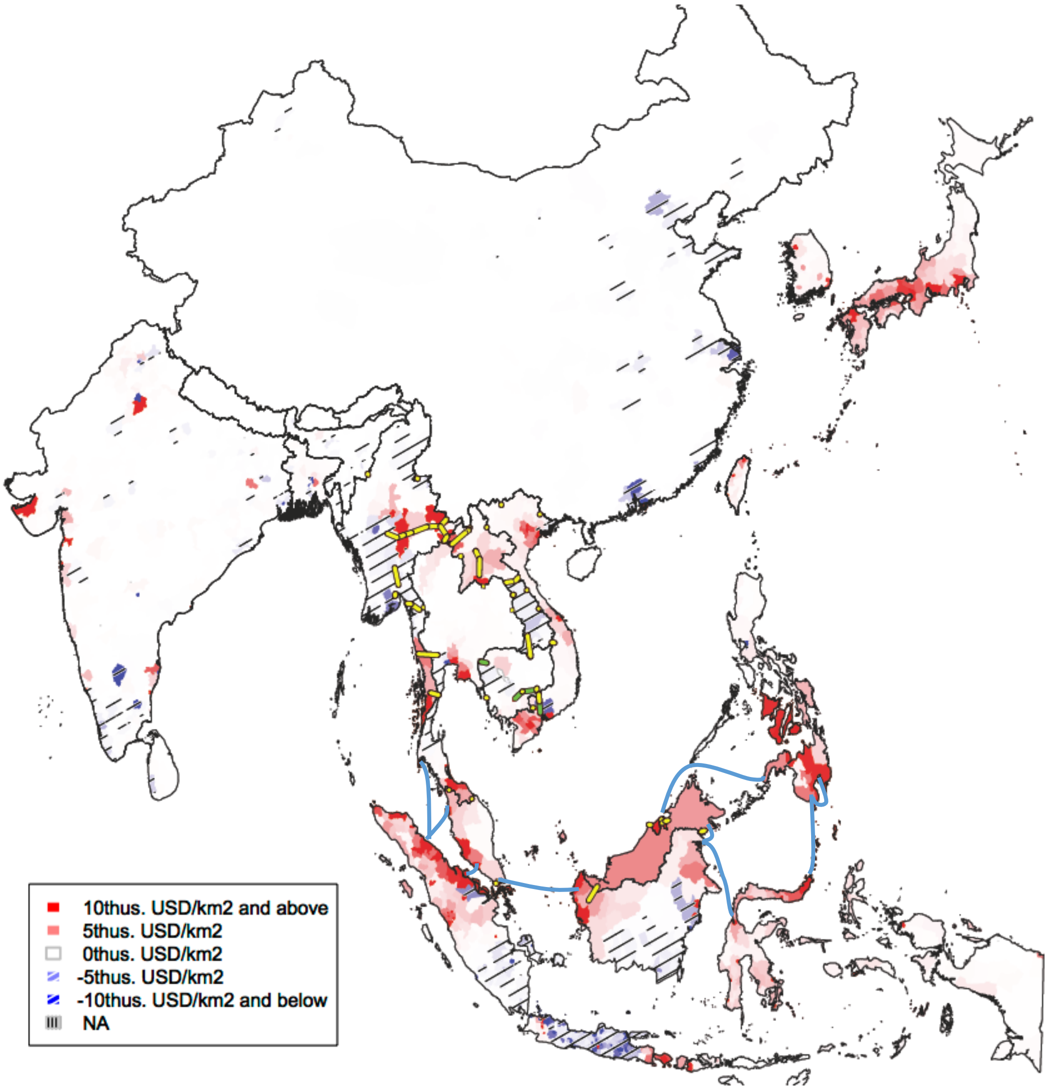
Figure 7 illustrates the result of the scenario. The regions with red color will have positive impacts and regions with blue color and hatched area will have negative impacts. We use a criterion of ‘impact density’, which is derived by dividing a GRDP difference between the baseline scenario and a development scenario by the land size of the region. The thicker tone a region has, the higher positive (or negative for hatched area) impact one square kilometer of land of the region will have with a development scenario. A combination of MPAC prioritized projects brings positive economic impact on the GDP of ASEAN member states while they are relatively small. In total, ASEAN will have a 6.8 percent increment of GDP in 10 years from 2021 to 2030 compared with the GDP in 2010.

The result of the simulation on MPAC prioritized projects, depicted in Figure 4, shows that these projects will positively impact ASEAN member states yet the positive impact will not be distributed to most regions in ASEAN. In particular, Yangon, surrounding regions of Yangon and northern regions in Myanmar, the southern provinces of Lao PDR, the southern part of Kalimantan and Sumatra, and most regencies in Java Island will have negative impacts compared with the baseline scenario.

Mainly three limitations result in limited positive impacts of MPAC prioritized projects. First, MPAC projects mainly include infrastructure projects connecting one ASEAN member state to another. It indicates that most projects in the MPAC connect a remote area in one ASEAN member state to a remote area of another and neglect other domestic infrastructure projects. Physical infrastructure projects in the MPAC positively affect the area close to the project site but do not benefit other areas. Therefore, the positive impacts do not prevail in the whole ASEAN as Figure 4 draws many ‘hatched’ regions in ASEAN. Moreover, those projects may prevent inflow of household and firms from remote areas to largest economic cities compared with the baseline scenario. They may slow down the economic development of the country by preventing the formation of economic clusters near the largest economic cities. Second, the projects do not include those connecting one ASEAN member state to surrounding non-ASEAN member states. Third, the project list has not been revised and thus does not include new projects, such as high-speed rail projects in Malaysia, Singapore, Thailand, and Indonesia.

Figure 7. Economic Impacts of 'All MPAC Projects' on GRDP/GDP

(2030, impact density, US dollar per km^2)



Note: Data unavailable for North Korea and Timor-Leste; data unavailable for Jammu and Kashmir.

Source: IDE/ERIA-GSM simulation result.

3.4 CADP Projects

The CADP emphasized the economic corridors and strategies on how to stimulate innovation and technological upgrading in the existing clusters and encourage firms to fragment the production blocks from existing clusters and emerging clusters by prioritizing provision of hard and soft infrastructure. In this regard, enhancing the connectivity between existing clusters and the connectivity of large cities to remote areas must be pursued strategically. The CADP also claims that there are key infrastructure that may dramatically change production networks and contribute to high economic growth. One good example of key infrastructure is the proposed Dawei deep sea port in Myanmar. The CADP clearly explained that the economic corridor connecting Ho Chi Minh City, Phnom Penh, Bangkok, and South Asia via the Dawei deep sea port should be prioritized to achieve higher economic growth in the region and narrow development gaps through the economic development of Myanmar and Cambodia.

According to CADP projects provided in the CADP 2010 and CADP 2.0, we select eight international economic corridor development and subregional development scenarios, that is, the MIEC, the Greater Mekong Subregion (GMS) East–West Economic Corridor, the GMS North–South Economic Corridor, development in the Indonesia–Malaysia–Thailand Growth Triangle (IMT), broader development in the IMT and surrounding regions (IMT Plus), development in the Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area (BIMP), broader development in the BIMP and surrounding regions (BIMP Plus), and development in the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). We have four sectoral development scenarios: (1) infrastructure development (All Infra.); (2) NTB reduction (NTB); (3) development of special economic zones (SEZs) in Cambodia, Lao PDR, Myanmar, and Viet Nam; and (4) combination of those three sectoral development scenarios (All-All). The economic impacts of the MPAC projects, selected economic corridor scenarios, and all CADP projects on ASEAN, as derived in Figure 2, are provided as Table 5.

Table 5. Grand Table: Economic Impacts in 10 Years Cumulation on ASEAN (2021–2030, %)

MPAC	MIEC	EWEC	NSEC	All Infra	NTB	SEZ	All-All
6.8	6.11	1.34	0.04	42.1	31.2	6.3	80.9

EWEC = East–West Economic Corridor, MIEC = Mekong–India Economic Corridor, MPAC = Master Plan on ASEAN Connectivity, NSEC = North–South Economic Corridor, NTB = non-tariff barrier, SEZ

= special economic zone.

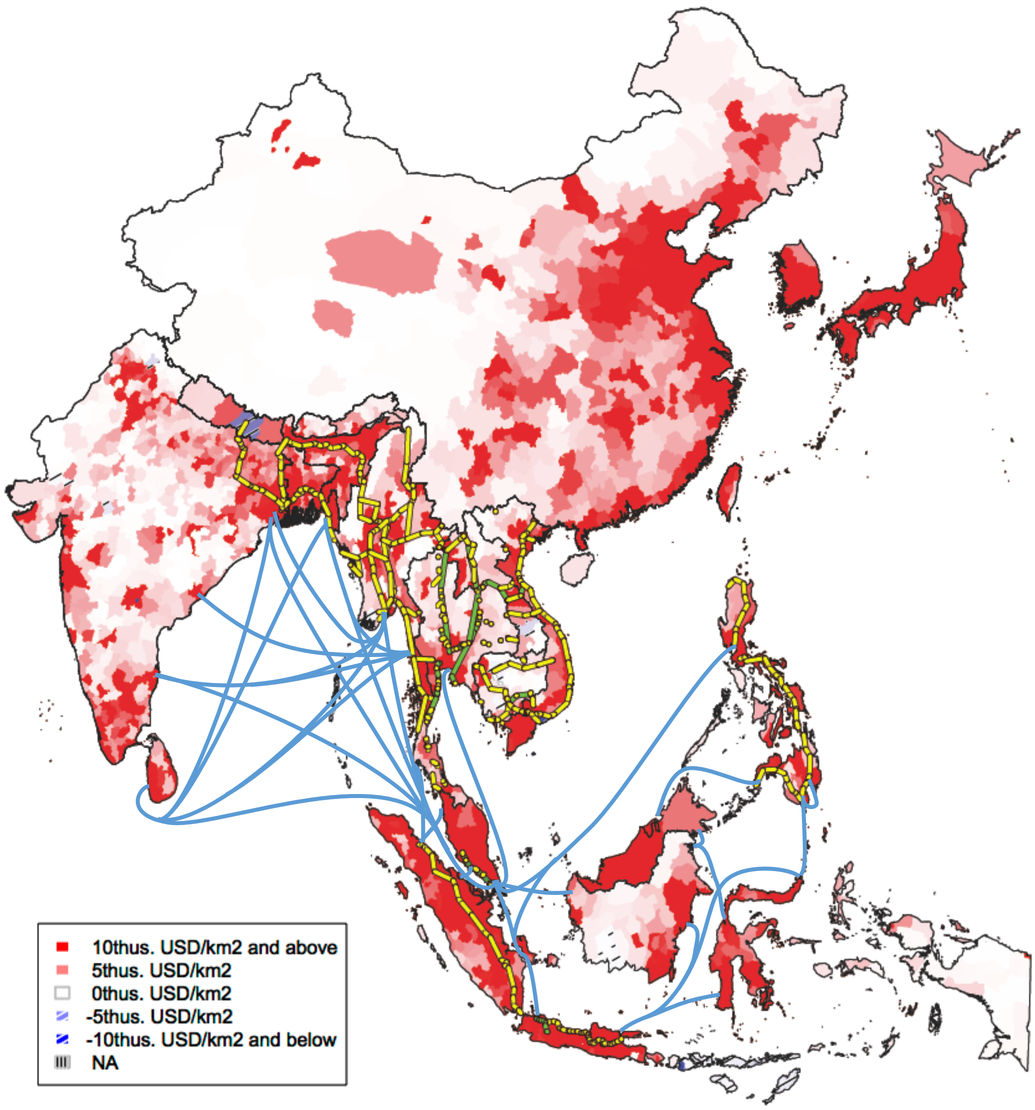
Source: IDE/ERIA-GSM simulation result.

In the NTB scenario, we assume an aggressive reform more than the baseline scenario. It can be achieved through liberalizing services in manufacturing-related services which streamlines trade in goods, enhancing the capacity of firms to complete trading procedures and finding trade partners, and implementing domestic regulatory reform to raise efficiency and transparency in operations for both foreign and domestic investors. Specifically, we assume an additional NTB reduction where country *A*, for example, gradually reduces NTBs from 2016 to 2025 up to the level of country *B* which is 10 ranks higher than country *A* in terms of the estimated NTB value among 185 economies. This assumption requires a drastic reform to the country to raise its competitiveness in the world to 10 ranks higher. It can only be made through a combination of regional cooperation and each economy's own effort.

For CLMV (Cambodia, Lao PDR, Myanmar, and Viet Nam) countries, just enhancing connectivity is not enough to catch up with other forerunners. They should consider establishing SEZs in strategic cities and provide better infrastructure for production. In the simulation analysis, we assume that the productivity parameter in selected cities will be raised through provision of better roads in a region, electricity and water supply, vocational training, and matching services between firms and potential workers. It should be noted that raised technological parameter does not always ensure higher economic growth with the simulation. If the raised technological parameter is favorable for the firms, more firms will locate in the region and production will be expanded; thus, positive impact will be highly expected. On the other hand, if the raised technological parameter is not attractive for firms at all or not attractive enough compared with other SEZs, firms will not decide to operate in the region; thus, the region will not experience a positive impact. The scenario for CADP projects is provided in Appendix B.

Figure 8 shows the overall impact of the All-All scenario of CADP projects, which will have more impact on the region. Moreover, most regions in ASEAN will be positively impacted. It should be noted that larger economic impacts of countries and wider coverage of regions with positive impacts can be achieved through the strategic provision of hard and soft infrastructure. In this regard, CADP projects can be a strategic solution to pursuing higher economic growth and narrowing development gaps.

Figure 8. Economic Impact of All Improvement (2030, Impact Density)



Note: Data unavailable for North Korea and Timor-Leste. Data unavailable for Jammu and Kashmir.

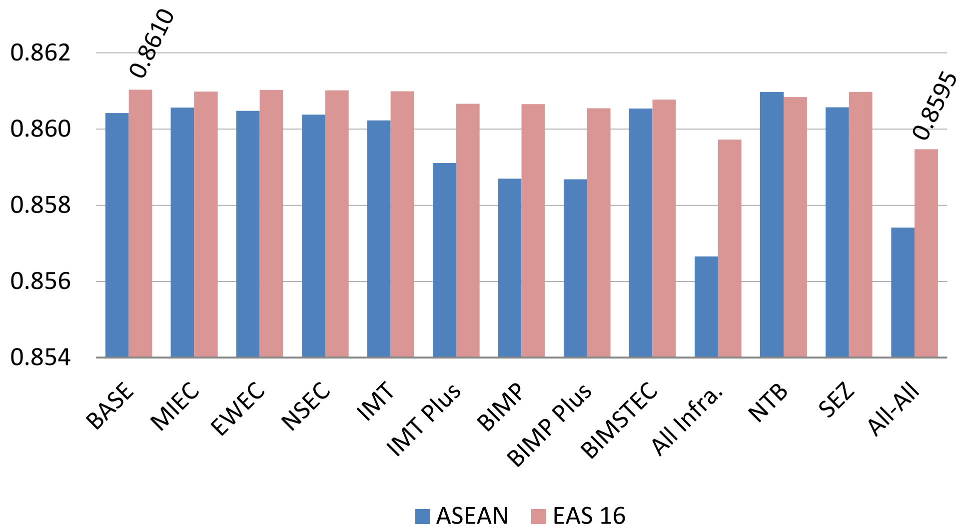
Source: IDE/ERIA-GSM simulation result.

3.5 Impacts on Gini and Traffic

Figure 9 shows the impact of each scenario on the spatial GINI of the 16 countries of

ASEAN and East Asia Summit. This spatial GINI was derived from per capita GDP and population of each subregion in selected countries. The coefficient takes 1 if all incomes are concentrated in one region, and takes 0 if all regions have the equal per capita GDP. In the simulation, the coefficient for East Asia as a region tends to decrease during the same period. This implies that the economic activities are expected to agglomerate intra-nationally, but disperse inter-nationally.

Figure 9. Economic Impacts on GINI (2030)



Source: IDE/ERIA-GSM simulation result.

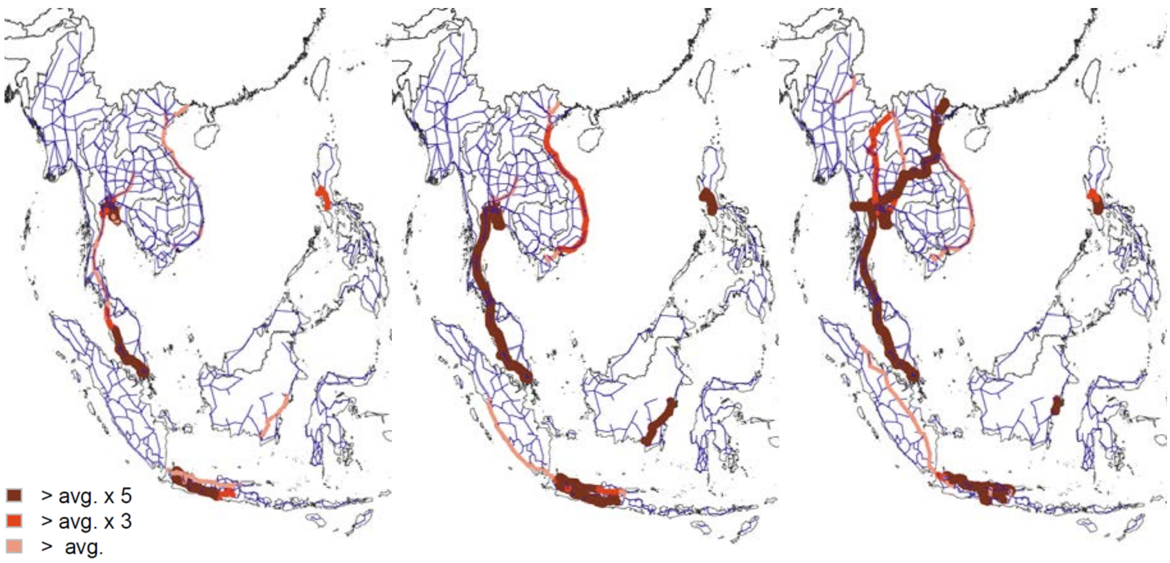
Compared with the baseline scenario, all scenarios will reduce the spatial GINI of the 16 countries, whereas the MIEC, East–West Economic Corridor, Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, NTB, and SEZ scenarios will increase the GINI of ASEAN. The All-All scenario will reduce GINI coefficients for both ASEAN and EAS 16. We find that BIMP, BIMP Plus, and All Infrastructure scenarios have a larger impact on reducing GINI coefficients.

NTB reduction has a relatively smaller impact on the GINI of East Asia Summit countries and worsens that of ASEAN. An explanation is that the regulatory reform will benefit large cities or existing clusters more than smaller cities or rural areas, although most of the regions will be positively impacted. This comparison of GINI coefficient informs that strategic infrastructure development can disperse and distribute the benefit towards smaller cities and rural areas.

Figure 10 shows the traffic change for intermediate goods of the automotive industry and electronics and electric appliances (E&E) industry. If we do not have any infrastructure and other facilitation measures and go as in the baseline scenario, traffic pattern will not change much from 2010 to 2030. If we have overall development as in the All-All scenario, we will see new transport corridors, such as the Ha noi–Bangkok–Dawei, NSEC, and Trans-Sumatran Highway, for the intermediate goods in the automotive sector. It implies that there are underlying demands for those corridors and we must provide sufficient capacity to meet the demand. At the same time, regions along the corridors can attract more firms and industries utilising increasing transport demand. On the other hand, result for the E&E sector tells us that said sector does not change much with the All-All scenario compared with the automotive sector. It can be interpreted as that air transport will be still dominant in the E&E sector even if we have better road and border facilitation in the Mekong region.

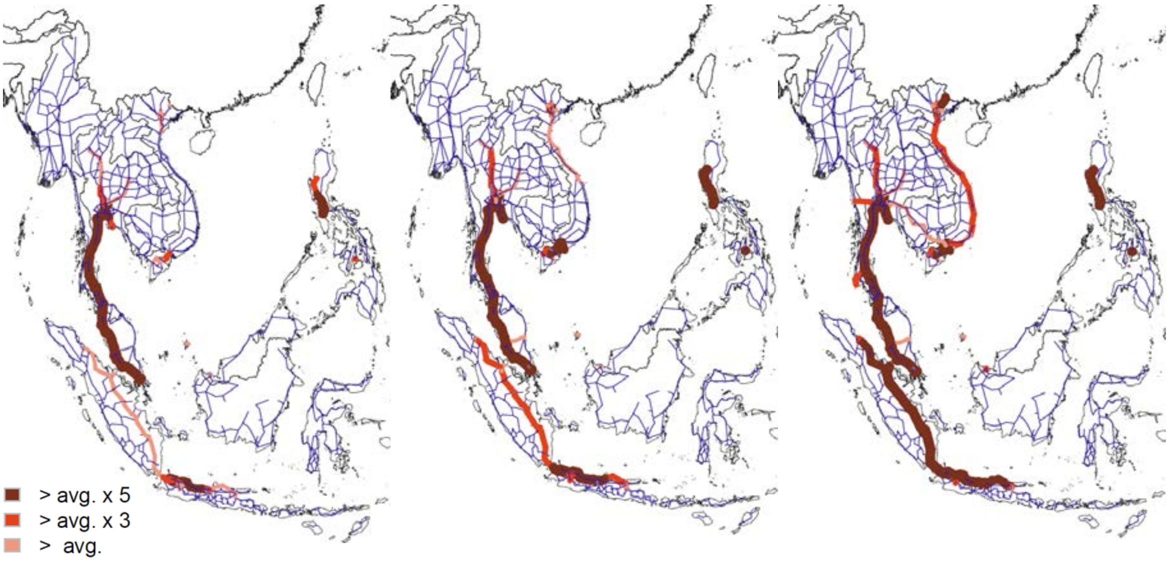
Figure 10. Traffic of Intermediate Goods in Automotive and E&E sectors in ASEAN's Automotive Sector

2010 Baseline 2030 Baseline 2030 All-All



E&E Sector

2010 Baseline 2030 Baseline 2030 All-All



Note: For all three figures, *avg.* is average traffic volume of ASEAN in 2030 in the baseline scenario.

Source: IDE/ERIA-GSM simulation result.

4. Policy Implications

In this paper, we propose how a simulation tool at the subnational level can be used for the analyses of various TTFMs by taking examples of ASEAN economic integration. The analyses at the subnational level are essential for effective policy making for regional development. It is also useful to see the impacts of TTFMs on regional income inequality. ASEAN economic integration is a complex process of various TTFMs, and it is not easy to predict the impacts without proper analytical tools. We hope this paper presents the usefulness of this type of simulation model and enhances further development and utilization of similar simulation models of policy formulation processes in East Asia.

We conclude this paper with some policy implications of the simulation analysis. First, each connectivity project in the MPAC will bring certain positive impacts as the results of the All MPAC Projects scenario present. Regions connected with upgraded roads and new RoRo routes will have positive economic impacts compared with the baseline scenario. Meanwhile, the geographic extension of the positive impacts from the projects may differ. Many projects on Below Class III and Missing link routes are mainly beneficial only to the limited areas along the routes. Regions along the upgraded and developed roads enjoy positive economic impacts; whereas Yangon has some negative impacts and countries other than Myanmar have negligible impacts. It can be pointed that MPAC projects are not enough to pursue higher economic growth for each ASEAN member state; they should be combined with domestic initiatives.

Second, we should be aware of the different characteristics of the projects. Some projects contribute to higher economic growth whereas others narrow development gaps. Facilitation at the borders brings positive impacts to Cambodian provinces near Thailand. However, the economic impact on the GDP of Cambodia might be negative because border areas attract more firms and households and economic agglomeration in Phnom Penh becomes smaller in the border facilitation scenario; also, smaller agglomeration in the capital city may impede faster economic growth of the country. We should strategically combine projects for higher economic growth and for narrowing development gaps. Again, the strategic combination of regional, subregional, and domestic projects—such as MPAC projects, expressway construction among main domestic cities, toll-way construction and provision of mass transit transport in urban areas, and upgrading of gateway ports— should be a solution to achieve both objectives and have greater economic impact with complementary and synergy effects. CADP projects give an example of the strategic combination of the projects.

Third, some critical cluster-to-cluster links have large impacts on ASEAN as a whole. The Dawei deep sea port project, together with a SEZ and a link with Thailand, will bring huge impacts on the Mekong region as a whole. Simulation results imply that regional funding initiatives should be pursued to those critical infrastructure projects, as surrounding countries may benefit from the Dawei project. At the same time, some key projects to connect ASEAN member states with a surrounding country should be regarded as prioritized projects in the coming new connectivity master plan because they will definitely contribute to higher competitiveness and tighter economic integration of ASEAN.

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APPNEDIX A: All MPAC Projects Scenario

(1) Upgrading Below Class III Sections in 2015

	AHN Projects in the AEC Blueprint
AH2	Improvement of Below Class III section out of total stretch connecting Meikthila, Loilem, and Kyaington
AH1(1)	Improvement of Below Class III section connecting Thaton and Myawaddy
AH1(2)	Improvement of Below Class III section connecting Chaung-U and Kalemyo

(2) Developing the Missing Links of AHN in 2015

	AHN Projects in the AEC Blueprint
AH112	Development of the missing link section to connect Lehnya and Khongloy
AH123	Development of the missing link section to connect Dawei and Maesamepass

(3) Developing the Missing Links of Singapore–Kunming Rail Link[1] in 2015

Aranyaprathet–Klongluk (Thailand) (6 km) in 2015
Poipet–Sisophon (Cambodia) (48 km) in 2015
Phnom Penh–Loc Ninh (Cambodia) (255 km) in 2015
Loc Ninh–Ho Chi Minh City (Viet Nam) (129 km) in 2020

(4) Border Facilitation in 2015

- Time and costs reduced by 50 percent at the 34 borders along the AHN

	AH No.	TTR	Border Checkpoints	
1	AH-1	TTR	Moreh (India)	Tamu (Myanmar)
2	AH-1	TTR	Myawaddy (Myanmar)	Mae Sot (Thailand)
3	AH-1	TTR	Khlong Luek (Thailand)	Poipet (Cambodia)
4	AH-1	TTR	Bavet (Cambodia)	Moc Bai (Viet Nam)

[1] Although it is difficult to think that the Phnom Penh–Loc Ninh section will be completed by 2015, we tentatively assumed the completion year as stated in the MPAC.

5	AH-1		Huu Nghi Quan (Viet Nam)	Youyiguan (China)
6	AH-2	TTR	Tachileik (Myanmar)	Mae Sai (Thailand)
7	AH-2	TTR	Sadao (Thailand)	Bukit Kayu Hitam (Malaysia)
8	AH-2		Johor Bharu (Malaysia)	Woodland (Singapore)
9	AH-3	TTR	Mohan (China)	Boten (Lao PDR)
10	AH-3	TTR	Houi Sai (Lao PDR)	Chiang Khong (Thailand)
11	AH-3		Daluo (China)	Mongla (Myanmar)
12	AH-11	TTR	Trapeing Kreal (Cambodia)	Veunkhame (Lao PDR)
13	AH-12		Thanaleng (Lao PDR)	Nong Khai (Thailand)
14	AH-13		Tay Trang (Viet Nam)	Taichang (Lao PDR)
15	AH-13		Muang Ngeun (Lao PDR)	Huai Kon (Thailand)
16	AH-14	TTR	Muse (Myanmar)	Ruili (China)
17	AH-14		Hekou (China)	Lao Cai (Viet Nam)
18	AH-15		Nakhon Phanom (Thailand)	Thakek (Lao PDR)
19	AH-15	TTR	Namphao (Lao PDR)	Keo Nua (Viet Nam)
20	AH-16	TTR	Mukdahan (Thailand)	Savannakhet (Lao PDR)
21	AH-16	TTR	Danesavanh (Lao PDR)	Lao Bao (Viet Nam)
22	AH-18		Sungai Kolok (Thailand)	Rantau Panjang (Malaysia)
23	AH-112		Khong Loy (Myanmar)	Bang Saphan (Thailand)
24	AH-123		Maesamepass (Myanmar)	Kanchanaburi (Thailand)
25	AH-123		Hat Lek (Thailand)	Cham Yeam (Cambodia)
26	AH-131		Kiamuoya (Lao PDR)	Mu Da (Viet Nam)
27	AH-132		Ban Het (Lao PDR)	Bo Y (Viet Nam)
28	AH-143		Johor Bharu (Malaysia)	Tuas (Singapore)
29	AH-150	TTR	Entikong (Indonesia)	Tebedu (Malaysia)
30	AH-150	TTR	Miri (Malaysia)	Sungai Tujoh (Brunei)
31	AH-150	TTR	Kuala Lurah (Brunei)	Limbang (Malaysia)
32	AH-150	TTR	Limbang (Malaysia)	Puni (Brunei)
33	AH-150	TTR	Labu (Brunei)	Lawas (Malaysia)
34	AH-150		Serudong (Malaysia)	Simangaris (Indonesia)

(5) Developing Roll On–Roll Off Routes in 2015

RoRo1: Zamboanga City (Philippines)–Muara (Brunei)
RoRo2: Davao City–General Santos (Philippines)–Bitung (Indonesia)
RoRo3: Johor (Malaysia)–Sintete (Indonesia)
RoRo4: Tawau (Malaysia)–Tarakan (Indonesia)–Pantoloan (Indonesia)

RoRo5: Dumai (Indonesia)–Malacca (Malaysia)
RoRo6: Belawan (Indonesia)–Penang (Malaysia)
RoRo7: Phuket (Thailand)–Belawan (Indonesia)

APPNEDIX B: CADP Projects

(a) All Infrastructure Scenario

(1) MIEC

Year	Scenario
2020	(1) Road Improvement along National Roads No. 5 and 1 in Cambodia (2) Road Improvement between Moc Bai and Cai Mep Port in Viet Nam (3) Road Improvement between Kanchanaburi and Dawei Port (4) Connecting Dawei and Chittagong, Dawei and Kolkata, Dawei and Visakhapatnam, Dawei and Chennai, and Dawei and Colombo by sea routes equivalent to internationally important routes (5) Border facilitation at borders between Poipet and Aranyaprathet, Bavet and Moc Bai, and Phu Nam Ron and Thiki

(2) East–West Economic Corridor

Year	Scenario
2020	(1) Road Improvement between Da Nang to Lao Bao in Viet Nam (2) Road Improvement between Densavanh to Kaysone Phomvihane in Lao PDR (3) Road Improvement between Kawkareik to Yangon in Myanmar (4) Border facilitation at borders between Myawaddy and Mae Sot, Mukdahan and Kaysone Phomvihane (Savannakhet), and Densavanh and Lao Bao

(3) North–South Economic Corridor

Year	Scenario
2020	(1) Road Improvement between Tachileik to Daluo in Myanmar (2) Road Improvement between Houayxay and Boten in Lao PDR (3) Border facilitation at borders between Mae Sai and Tachileik, Daluo and Mong La, Chiang Khong and Houayxay, and Boten and Mohan

(3) Indonesia–Malaysia–Thailand Growth Triangle Plus

Year	Scenario
2020	(1) Road Improvement along Trans-Sumatran Highway between Medan and Bakaheuni (2) KL-Singapore High Speed Rail Link (3) New RoRo route between Tanjung Pelepas and Sambas (4) New RoRo route between Malacca and Dumai (5) New RoRo route between Penang and Belawan and Phuket and Belawan

(4) BIMP Plus

Year	Scenario
2020	(1) Road Improvement along Trans-Java Highway between Cirebon and Surabaya (2) Road Improvement along Pan-Philippine Highway between Laoag and Guiguinto, Santo Tomas and Matnog, Allen to Liloan, and Lipata and Ipil (3) New RoRo route along Davao-General Santos-Bitung (4) New RoRo route between Zamboanga and Muara (5) New RoRo route along Tawau-Tarakan-Palu (6) Sea route improvement between Manila and Singapore, Singapore and Jakarta, and Jakarta and Manila (7) Sea route improvement between Surabaya and Makassar (8) Sea route improvement between Surabaya and Balikpapan (9) Sea route improvement between Surabaya and Bitung (10) Jakarta–Bandung High Speed Railway

(5) Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

Year	Scenario
2020	(1) Road Improvement between Kawkareik and Yangon, and Payagyi and Tamu in Myanmar (2) Road Improvement between Moreh and Kolkata, Raxaul and Kolkata and Petrapole and Kolkata in India (3) Road Improvement between Benapole and Teknaf in Bangladesh (4) Road Improvement between Birgunj and Kathmandu in Nepal (5) Border facilitation at borders between Mae Sot and Myawaddy, Tamu and Moreh, Petrapole and Benapole, and Raxaul and Birgunj (6) Sea route improvement at selected routes: (7) Port Laem Chabang–Port Singapore (8) Port Singapore–Port Yangon (9) Port Chittagong–Port Singapore (10) Port Haldia–Port Singapore (11) Port Madras–Port Singapore (12) Port of Colombo–Port Singapore (13) Port Calcutta–Port Yangon (14) Port Yangon–Port Madras (15) Port Yangon–Port of Colombo

	(16) Port of Colombo–Port Haldia (17) Port of Colombo–Port Chittagong

(6) Others

Year	Scenario
2020	(1) Domestic infrastructure development in Myanmar (2) Expressway construction between Ha Noi and Ho Chi Minh City (3) High-speed rail in Thailand (4) Border facilitation at ASEAN borders and for borders between ASEAN countries and surrounding countries. (5) Port and airport expansion to prevent congestion in East Asia

(b) NTB Reduction Scenario

(1) Additional NTB reduction from 2016 to 2025 every year for selected countries:

Country	**%**
Bangladesh	1.46
Bhutan	2.12
Brunei Darussalam	2.18
Cambodia	1.31
China	1.69
India	1.80
Indonesia	1.97
Lao PDR	1.81
Malaysia	1.44
Myanmar	3.48
Nepal	2.45
Philippines	1.05
Sri Lanka	1.42
Thailand	1.30
Viet Nam	1.23

(c) Special Economic Zone (SEZ) Scenario

(1) Productivity Improvement for specific SEZ sites in Cambodia, Lao PDR,

Myanmar, and Viet Nam

By five percent in 2015:

- Ha Noi
- Ho Chi Minh
- Bien Hoa
- Hai Duong
- Sisophon
- Batdambang
- Phnom Penh
- Krong Preah Sihanouk
- Svay Rieng
- Ta Khmau
- Kaoh Kong
- Vientiane Capital
- Pakxanh
- Thakhek
- Khanthabuly
- Pakse

By five percent in 2020:

- Hpa-An
- Myawaddy
- Mandalay
- Muse
- Yangon
- Tachileik
- Kengtung
- Kyaukpyu

By 50 percent in 2020:

- Dawei

(d) All-All Scenario

(1) All improvements of infrastructure, NTB reduction, and SEZ