Chapter 4

Economic Assessment of the CADP: The Geographical Simulation Model

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CHAPTER 4.

ECONOMIC ASSESSMENT OF THE CADP: THE GEOGRAPHICAL SIMULATION MODEL

The Geographical Simulation Model (GSM) developed by a team of researchers from the Institute of Developing Economies, Japan External Trade Organization (IDE-JETRO) has been a primary device in quantifying the economic impacts of logistics improvement in accordance with the conceptual framework of the CADP. The simulation model will be referred to as the IDE/ERIA-GSM hereinafter. The IDE/ERIA-GSM is an extended version of the Core-Periphery Model (Krugman, 1991) to incorporate multiple industrial sectors and intermediate goods. The third generation of the IDE/ERIA-GSM was developed in a supporting study project for the CADP, and the description in this chapter is largely based on Kumagai, et al (2010).

4-1. Geographical Simulation Model (GSM)

4-1-1. Development of the IDE/ERIA-GSM

The IDE/ERIA-GSM has been in development since 2007 when 16 research institutes in EAS member countries launched several test-run projects under the initiative towards the establishment of ERIA. The primary objective of the IDE/ERIA-GSM is to investigate the dynamics of the location of populations and industries in East Asia in the long run. Although there have been many undertakings to make macroeconomic forecasts at the national level, except for a very limited amount of literature, there has been no analysis using spatial simulation models to investigate economic development in East Asia at the subnational level. In view of deepening regional economic integration and significant disparities within countries, economic analyses at the national level are insufficient to provide useful information for regional economic cooperation. The second objective is to analyze the economic impacts of specific infrastructure projects on the regional economy at the subnational level. It is difficult to prioritize various infrastructure development projects without a proper and objective evaluation device.

The first-generation IDE/ERIA-GSM was published in Kumagai *et al* (2008a, 2008b), as a result of an ERIA test run project on "International Infrastructure Development in East Asia: Towards Balanced Regional Development and

Integration." Focusing on the Greater Mekong Subregion (GMS), the first-generation IDE/ERIA-GSM covered 220 subnational regions in 8 countries, connected with 457 road links. And the regional GDP was divided into 3 broad industrial sectors; agriculture, manufacturing, and services.

The most notable departure of the second-generation IDE/ERIA-GSM was made in sectoral disaggregation (Kumagai, *et al* 2009). By disaggregating the manufacturing sector into 5 subsectors, the second-generation IDE/ERIA-GSM contains seven sectors: (1) agriculture, (2a) automotive, (2b) electric and electronics, (2c) textile and garments, (2d) food processing, (2e) other manufacturing, and (3) services. This development enabled us to make more precise investigations into the impacts of infrastructure development with respect to each industrial sector. In addition, the second-generation IDE/ERIA-GSM expanded the geographical scope including 361 subnational regions in 10 countries, connected with 693 road links. The geographical focus was still on the GMS, and the mode of transportation was limited to road transportation.

The third-generation IDE/ERIA-GSM made a significant development by incorporating maritime and air transportation, and a realistic mechanism of modal choice. This development enabled us to expand the geographical scope of the model to include all ASEAN member States. As a result, the number of subnational regions increased to 956, spanning 13 countries. The number of routes increased dramatically to 2,648, which comprised 1,890 road links, 488 sea links, and 270 air links.

4-1-2. The third-generation IDE/ERIA-GSM

(1) Basic features

The IDE/ERIA-GSM has been developed as an economic geography model for the purpose of predicting the impacts of infrastructure development projects on the economy at the subnational level. The third-generation IDE/ERIA-GSM differs from the second-generation version in the following points: (1) geographic coverage has been expanded to cover ASEAN 10, Bangladesh, and parts of China and India, and (2) it incorporates realistic modal choice among land, sea, and air transport. These improvements enable better analysis of a wider variety of scenarios and provide more reliable results.

The third-generation IDE/ERIA-GSM is a cutting-edge economic model that incorporates realistic geography and modal choice. Various analyses show that the economic impacts of logistics infrastructure developments are somewhat complicated and differ significantly by industry. Development plans should thus be carefully designed and, to that end, an analytical device like the IDE/ERIA-GSM has much to contribute.

The third-generation IDE/ERIA-GSM confirms that regional infrastructure development projects would benefit most regions along corridors and near ports and airports. However, large-scale infrastructure development may widen existing income gaps, i.e., rich regions may become richer and poor regions may become poorer. In particular, intranational economic gaps may widen during the phase of economic development, given the restrictions on the international mobility of the labor force..

We should be very cautious when considering regional infrastructure development because the economic improvement of all involved regions is not automatically assured. The regions affected by an infrastructure development project are often wider than one may imagine. An infrastructure development project might create winning regions/industries and losing regions/industries, and could lead to quite drastic modal shifts for certain origin-destination combinations. As a result, there is a possibility of under- or over-unitization of specific roads/ports/airports. Thus, we need to design infrastructure development projects taking due account of the impacts on wider regions and on other modes of transport. It is thus a sensible policy option to establish an international body to coordinate regional transport infrastructure development projects

As discussed in Chapter 1, the Comprehensive Asia Development Plan (CADP) aims to provide a grand spatial design of economic infrastructure and industrial placement, with a claim that we can pursue both the deepening of economic integration and the narrowing of development gaps at the same time. The IDE/ERIA-GSM, sharing common theoretical underpinnings with the CADP, can be a powerful device to verify the claim of the CADP, by quantifying the economic impacts of transport/logistic infrastructure development.

(2) Agglomeration and dispersion forces in the IDE/ERIA-GSM

In the IDE/ERIA-GSM, infrastructure development and trade facilitation measures are used as policy instruments. These policies are input to the model in terms of reduction in the time and money costs to connect subnational regions. In the conceptual framework of the CADP, these costs are termed as service link costs. The reduction of service link costs connecting a region to others will reduce the cost of purchasing intermediate goods to be used in the region, and increase the demand for the goods produced in the region. Through both channels, the profits of firms operating in the region are expected to grow.

Once the profits of firms in a region increase, more firms will be attracted to operate in that region. And the increase in the number of firms operating in the region will further reduce costs for part procurement, thereby providing those firms with a greater chance to increase their profits. This is a form of agglomeration forces. The higher profit will enable firms to pay higher wages to their employees, and the higher wages will attract more people to work in the region. The increased population will enlarge the market size of the region. The bigger market will enable firms in the region to increase their profits. This is the second form of agglomeration forces.

On the other hand, dispersion forces will work in the following way. The more firms are operating in a region, the more competition the firms have to face. Fierce competition will have negative impacts on the firms' profits. Besides that, more demand in a region will raise the price levels in the region, and lower real wages in the region. These negative pressures on firms' profits and real wages will persuade firms and workers to move out of the region, in search of regions with less competition and lower price levels, respectively. This is a form of dispersion forces built in the IDE/ERIA-GSM.

(3) Modal choice

As already mentioned, the third-generation IDE/ERIA-GSM includes 956 subnational regions in 13 countries, and these subnational regions are connected with 2,648 transport links consisting of 1,890 road links, 488 sea links, and 270 air links. In the IDE/ERIA-GSM, all of these links are incorporated with a reasonable mechanism of modal choice. In the model, each firm decides the route and mode of transport taking into account both money and time costs. The IDE/ERIA-GSM adopts the modal mix that minimizes the total transport costs and calculates an iceberg-like transport parameter, dividing minimum transport costs by the standardized value of the goods by industry.

(4) Transport Costs

In the third-generation IDE/ERIA-GSM model, transport costs are dealt with in a completely different way compared with the past two models, where the traditional "iceberg" transport costs were assumed. First, we calculate the money-equivalent transport costs of transporting one 20-foot container by industry and mode, for every origin-destination combination. Then, we calculate the percentage of these transport costs against the value of one 20-foot container filled with the following goods, namely, automotive products, electrical and electronic products, textile and garments, food, and other manufactured goods. This number is treated as T_{ijkm}, the transport costs between city i and j for goods k by mode m.

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(5) Labor Mobility

Parameters on labor mobility are set on three levels, namely, international labor mobility (γ_N), intra-national, or intercity labor mobility (γ_C), and inter-industry labor mobility (γ_I) within a region. If γ=0.1, it means that a country/region/industry with two times higher real wages than the average attracts a 10 percent labor inflow a year. The IDE/ERIA-GSM assumes γ_N=0, γ_C =0.02, and γ_I=0.05. These assumptions mean respectively that international migration of labor is prohibited, that a region with two times higher real wages than the national average induces a 2 percent labor inflow a year, and that an industrial sector with two times higher real wages than the average in the region induces a 5 percent labor inflow from other industrial sectors in a year.

(6) Limitations

Despite a number of promising features of the IDE/ERIA-GSM, there still remain several limitations to be noted here. First of all, the sources of economic growth in the third-generation IDE/ERIA-GSM are still limited to population growth, domestic migration (inter-regional and inter-sectoral), and impacts of infrastructure development. In order to quantify the impacts of infrastructure development in terms of value, it is necessary to make specific assumptions on the parameters for broadly defined technological progress. And the value is highly dependent on the assumption, which will require us to conduct much more extensive study. *Ad hoc* assumptions will only lead to unreliable results. Therefore, in the next sub-section, we will demonstrate the simulation results in terms of the percentage ratio of cumulative effects on regional GDP over 10 years (2011-2020) vis-à-vis the baseline level of regional GDP in 2010. At this point, this normalization is the only available and justifiable way to demonstrate the simulation results from the IDE/ERIA-GSM.

Secondly, the IDE/ERIA-GSM has not yet incorporated railways and inland waterways, which have played a significant role in specific regions. According to JETRO (2009), the share of inland waterways in total freight volume was about 42% in Myanmar (2003), 20% in Lao PDR (2005) and Vietnam (2004), and the share of railways was about 35% in Myanmar (2003), although it should be noted the data are old and far from complete. In addition, there remains more to do to improve the data for existing modes of transportation, particularly in air and sea transportation. As a result, the modal choice in the current version of the IDE/ERIA-GSM tends to choose routes that use the minimum distance to transport goods while disregarding the "hubness" of nearby ports/airports.

Thirdly, although an aspect of trade facilitation measure is incorporated in terms of the time and money costs for international transaction, non-tariff barriers (NTBs) are not introduced in the model. NTBs have become a focus of policy discussion particularly in ASEAN, reflecting the significant progress made in tariff reduction under AFTA. In order to highlight this issue, the IDE/ERIA-GSM needs to be updated to incorporate NTBs to enable us to investigate the impacts of broadly defined trade and transport facilitation measures. This again requires much more extensive study.

Fourthly, by allowing domestic migration in response to infrastructure development, we implicitly assume that other economic infrastructure, such as electricity and water, are available to meet the demands of economic activity. In reality, however this is not the case. Therefore, in interpreting the results from the IDE/ERIA-GSM, we need to pay particular attention to the additional requirements for the development of other economic infrastructure.

Last but not least, the data set used in the simulation is still far from perfect in terms of precision and accuracy. The third-generation IDE/ERIA-GSM requires a number of detailed statistics such as regional GDP in 956 subnational regions with 7 sectors and employment in each sector in each subnational region, which is not readily available for most of the countries in the model. In order to pursue informed policymaking in regional cooperation, it is expected that EAS member countries would cooperate to compile a unified geo-economic data set. EUROSTAT offers a very challenging but promising example.

4-2. Economic effects of logistics enhancement: simulation results

This section presents simulation results based on IDE/ERIA-GSM, in terms of the cumulative gains in regional GDP for 10 years (2011-2020) after transport cost reductions as a percentage difference from the baseline level of regional GDP in 2020.

Before examining the details, it should be noted that the simulation analyses presented here intend to examine the economic effects of logistic enhancement in terms of the reduction in money and time costs to connect various regions, instead of the impacts of specific infrastructure projects such as road improvement, highway development, upgrading of ports, and so on. In addition, the simulation scenarios do not incorporate the economic impacts of other policy measures, such as the development of power plants, special economic zones, trade and investment liberalization, and so on. Moreover, as mentioned in the last sub-section, the IDE/ERIA GSM is not designed to forecast economic growth. Therefore, the simulation results presented in this sub-section should be regarded as distributional impacts of hypothetical logistics enhancement.

4-2-1. Scenarios

(0) Baseline

Population growth and migration (labor mobility)

- The national population of each country is assumed to increase at the rate forecasted by the United Nations Population Fund (UNFPA) until year 2025;
- There is no immigration between the region covered in the simulation and the rest of the world.
- There is no international immigration between countries in the model.
- Domestic migration, both inter-region and inter-sectoral, is allowed depending on the difference in real wages.

Land transportation

- The average speed of land traffic is set at 38.5 km/h. However, the speed for passing through a mountainous area is halved or set at 19.25 km/h.

Sea transportation

- The average speed is set at 14.7 km/h between international-class ports, and at half of that among other routes.
- International-class ports: Port Singapore, Port Madras, Port Hong Kong, Port Saigon, Port Jakarta, Port Manila, Port Laem Chabang, and Port Kelang.
- The average speed between Port Singapore and Port Hong Kong is set at 39.4km/h, double the usual average speed, considering the "hubness" of the two ports.
- We introduced RO-RO vessels between some sea routes in the Philippines and Indonesia. The average speed is set at 14.7 km/h, and waiting time is 2 hours and costs 100USD.

Air transportation

- The average speed is set at 800 km/h between the primary airports of each country and at half of that among other routes.
- Primary airports: Brunei, Changi (Singapore), Hong Kong, Kuala Lumpur, Ninoy Aquino (Manila), Soekarno Hatta (Jakarta), Suvarnabhumi (Bangkok), Phnom Penh, Yangon, Wattay (Vientiane), Noi Bai (Hanoi), and Tansonnhat (Ho Chi Minh).

Time and money costs for transaction

- At national borders, the following time and money are assumed to be required by transport mode.

	Time cost (Hours)	Money cost (USD)
Land	13.22	500
Sea	14.97	504
Air	12.81	1,308

- To use the sea and air routes, the following time and money are assumed to be required even if it is an intra-national transaction.

	Time cost (Hours)	Money cost (USD)
Sea	11.67	190

	Air	9.01	690

(1a)	East West Economic Corridor (EWEC)
	● The overhead time consumed at three borders, i.e., Myawadi (Myanmar) – Mae Sot (Thailand), Mukdahan (Thailand) – Khanthabuly (Lao PDR), and Densavanh (Lao PDR) – Lao Bao (Vietnam), is reduced to two hours. In addition to that, the money costs of transiting these borders are reduced to 100USD, one-fifth of the baseline scenario. ● The average speed on EWEC is set at 60km/h.
(1b)	East-West Economic Corridor: Missing Link (EWEC-ML)
	● The average speed on the missing link of EWEC, i.e., Myawadi– Mawlamyine (Myanmar), is set at 60km/h.
(2)	North South Economic Corridor (NSEC)
	● The overhead time consumed at five borders, i.e., Mohan-Boten, Tachilek-Mae Sai, Chiang Khong-Houayxay, Hekou-Lao Cai, and Mongla-Daluo, is reduced to two hours. The money costs of transiting these borders are reduced to 100USD, one-fifth of the baseline scenario. In addition to that, the quality of the road in Myanmar along NSEC is upgraded to the same level as the other NSEC routes. ● The average speed on NSEC is set at 60km/h.
(3a)	Mekong-India Economic Corridor (I): A Mekong Bridge in Neak Loueng
	● The bridge over the Mekong River at Neak Loueng is constructed.
(3b)	Mekong-India Economic Corridor (II): Ho Chi Minh to Dawei
	● The bridge over the Mekong River at Neak Loueng is constructed. ● Dawei and Kanchanburi in Thailand are connected by road, and customs facilitation along MIEC is introduced. This reduces time overheads incurred at three borders (Kanchanburi–Dawei, Ban Khlong Luek–Poipet, and Bavet–Moc Bai) to two hours while the money costs incurred in going through these borders are reduced to 100USD, one-fifth of the baseline scenario.
(3c)	Mekong-India Economic Corridor (III): Full Spec
	● The bridge over the Mekong River at Neak Loueng is constructed. ● Dawei and Kanchanburi in Thailand are connected by road, and customs facilitation along MIEC is introduced. This reduces time overheads at three borders (Kanchanburi–Dawei, Ban Khlong Luek–Poipet, and Bavet–Moc Bai) to two hours while the money costs incurred in transiting these borders are reduced to 100USD, one-fifth of the baseline scenario. ● We connect Dawei and Port Madras by a sea route that is equivalent to the other routes between internationally important ports. ● The average speed on the land part of MIEC is set at 60km/h.
(4)	Three Corridors in Mekong (3ECs)
	● Implement the EWEC, NSEC and MIEC at the same time.

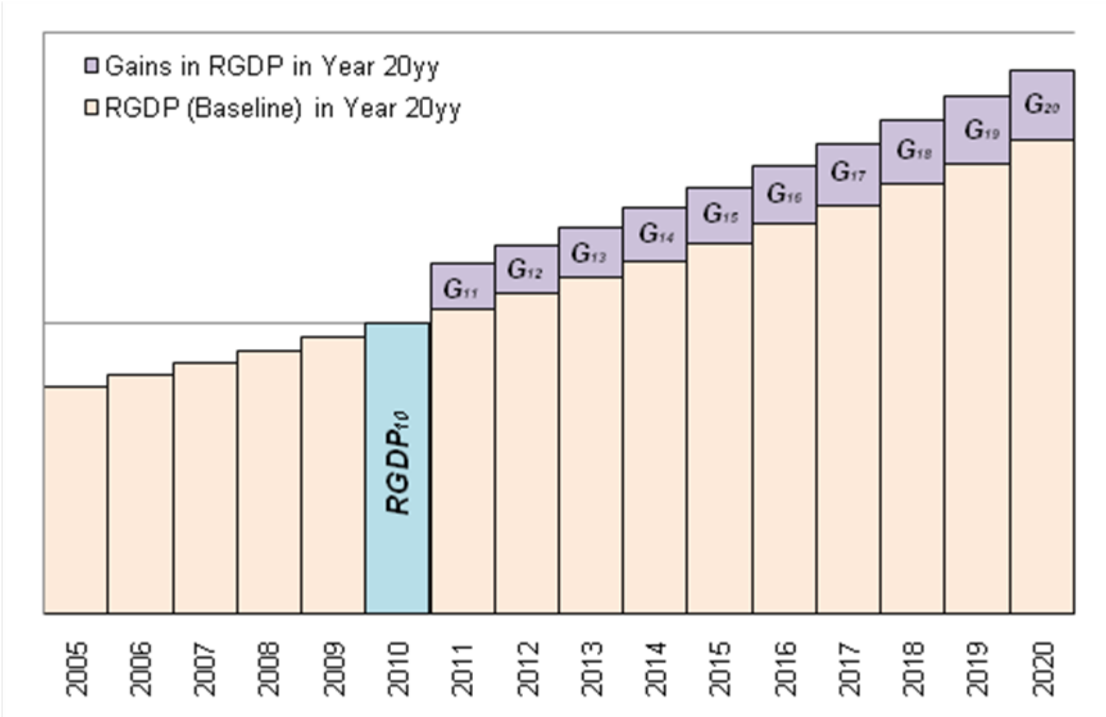
(5)	IMT+
	● The highway, on which vehicles can run at 60 km/h, starts at Bandar Aceh and goes through the eastern part of Sumatra Island ending at Jakarta. At the Sunda Strait, the speed of RO-RO vessels connecting Bakaheuni and Merak are doubled to 39.4km.h, and the waiting time and cost are reduced to 1 hour and 50USD respectively. ● Port Belawan-Port Penang and Port Dumai-Port Malacca, are connected by RO-RO vessels.
(6)	BIMP+ (Ring)
	● The land routes between Jakarta and Surabaya, and Manila-Davao are upgraded, meaning cars can run on them at 60 km/h. ● The sea routes of Manila-Singapore-Jakarta are upgraded, meaning the average speed is set at 22.5km.h, 1.5 times that of the other internationally important sea routes, and the time and money costs at the ports are reduced to half of the baseline scenario. ● The sea routes of Davao-Manado, Manado-Surabaya, Makassar-Surabaya and Balikpapan-Surabaya are also upgraded, meaning the speed is doubled and border costs (time and money) are reduced to half of the original baseline scenario. ● The speed of RO-RO vessels connecting three sea routes in the Philippines are doubled to 39.4km.h, and the waiting time and cost are reduced to 1 hour and 50USD respectively.
(7)	All-corridors
	● Implement the EWEC, NSEC and MIEC, IMT-GT and the Ring route at the same time.

4-2-2. Simulation results

This subsection presents simulation results based on the scenarios specified above. The economic effect of an infrastructure project is measured as the percentage ratio of cumulative gains in regional GDP over 10 years (2011-2020), after the completion of the scenarios of infrastructure development and trade facilitation in 2010, vis-à-vis the baseline level of regional GDP in 2010. In other words, the economic effect is calculated as follows.

$$\text{Economic Effect (\%)} = \frac{\sum_{y=11}^{20} G_{yy}}{RGDP_{10}}$$

Figure 4-1. Measuring economic effects in GSM: An illustration



(1) East West Economic Corridor (EWEC)

Figure 4-2-1a illustrates the economic effect of the East West Economic Corridor (EWEC) over 10 years after the implementation of the set scenario.

As illustrated in Figure 4-2-1a and Table 4-2-1a, all regions along EWEC gain although the size of the impacts tends to be larger in lower-income regions, such as Khammouan (166.2%) and Xekong (116.2%) in Lao PDR, Taninthayi (96.0%) and Mon in Myanmar (95.8%). In addition, we observe that the positive impacts spread far beyond the regions adjacent to EWEC, including all regions in Myanmar and some regions in China, Malaysia, and Indonesia. On the other hand, it should be noted that the number of regions affected negatively by the EWEC (611 out of 956 regions) is much greater than those which enjoy positive impacts (345 regions). However, as the magnitude of the negative impacts is much smaller than that of the positive impacts, the total economic effect in the regions covered in this analysis is positive, 0.78%.

In terms of countries, Myanmar gains most (44.3%), followed by Lao PDR (27.3%), Thailand (20.8%) and Vietnam (7.5%). Indeed, most countries are worse off, including a neighboring country, Cambodia (-0.3%)[1].

[1] For China and India, the economic effect is calculated as the sum of economic effects in the regions covered by the IDE/ERIA-GSM, as indicated in Figure 4-2-1a.

In reality, most parts of the EWEC are already developed, mainly under the Greater Mekong Subregion (GMS) program led by the Asian Development Bank (ADB). In order to obtain a clearer insight, we also investigated the economic effect of the development of the missing link along the EWEC, namely, the section between Myawadi and Mawlamyine in Myanmar.

As shown in Figure 4-2-1b, positive economic impacts can be observed mainly in Myanmar. Most of the top 10 gainers are regions in Myanmar, such as Mon (77.2%), Taninthayi (77.1%), and Kayin (51.1%). Indeed, with only this infrastructure development, Myanmar would enjoy significant positive impacts amounting to 36.3%. In this scenario, we can again observe wide diffusion of the economic impacts, although the magnitudes are much smaller than in the case of EWEC as a whole. Reflecting upon the small but negative impacts on a large number of regions, the total economic effect on the whole region would fall into negative territory, -0.11%.

Again, the number of regions positively affected under this scenario is smaller than those negatively affected, while the size of positive impact on the region is generally larger than that of negative impacts. These findings imply that the economic effects of infrastructure development should be evaluated from a wider point of view taking due account of the economic chain reaction. In other words, in designing infrastructure development plans in ASEAN and surrounding regions to pursue both the deepening of economic integration and the narrowing of development gaps, it is important to consider multiple economic corridors.

Figure 4-2-1a. Economic effects of EWEC

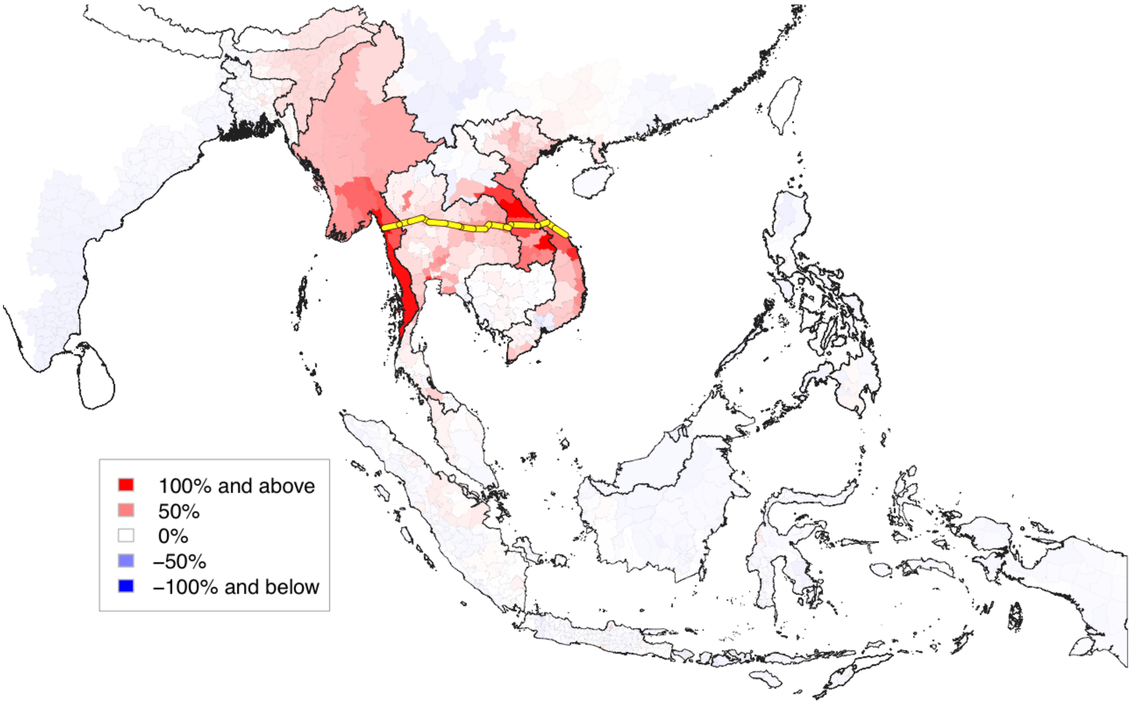


Table 4-2-1a. Ranking of economic effects: EWEC

EWEC				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Khammouan	Lao PDR	166.2%	Myanmar	44.3%
Xekong	Lao PDR	116.2%	Lao PDR	27.3%
Tanintharyi	Myanmar	96.0%	Thailand	20.8%
Mon	Myanmar	95.8%	Vietnam	7.5%
Samut Sakhon	Thailand	88.6%	Bangladesh	0.9%
Quang Ngai	Vietnam	85.7%	Malaysia	0.8%
Bolikhamxai	Lao PDR	78.8%	Cambodia	-0.3%
Savannakhet	Lao PDR	71.5%	Indonesia	-2.2%
Kayin	Myanmar	67.8%	India	-2.4%
Da Nang City	Vietnam	67.0%	Philippines	-2.5%
Number of regions with	100% or more	2	China	-2.7%
	50% to 100%	17	Singapore	-4.2%
	0% to 50%	326	Brunei	-4.4%
	Less than 0%	611	Hong Kong	-4.6%
Total Economic Effect in 956 Regions		0.78%	Macao	-4.7%

Figure 4-2-1b. Economic Effects of EWEC (Missing Link)

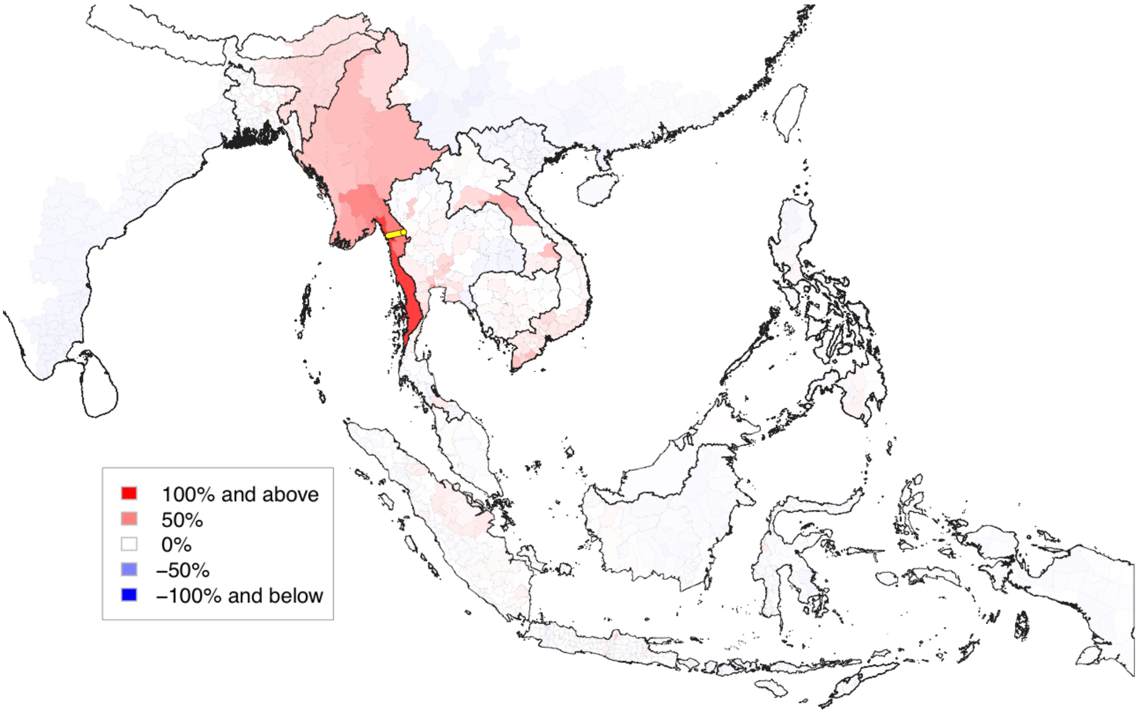


Table 4-2-1b. Ranking of economic effects: EWEC (missing link)

EWEC-ML				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Mon	Myanmar	77.2%	Myanmar	36.3%
Taninthayi	Myanmar	77.1%	Thailand	5.6%
Kayin	Myanmar	51.1%	Lao PDR	5.5%
BAGO	Myanmar	47.6%	Vietnam	4.4%
Samut Sakhon	Thailand	40.8%	Bangladesh	1.7%
Yangon	Myanmar	38.8%	Cambodia	1.3%
Ayeyawaddy	Myanmar	33.7%	Philippines	-0.1%
Kayar	Myanmar	31.0%	Indonesia	-0.4%
Bolikhamxai	Lao PDR	30.6%	Malaysia	-0.5%
Shan	Myanmar	29.4%	India	-1.6%
Number of regions with	100% or more	0	China	-2.1%
	50% to 100%	3	Singapore	-2.3%
	0% to 50%	343	Brunei	-2.6%
	Less than 0%	610	Macao	-2.7%
Total Economic Effect in 956 Regions		-0.11%	Hong Kong	-2.7%

(2) North South Economic Corridor (NSEC)

Figure 4-2-2 illustrates the economic effects of the North-South Economic Corridor (NSEC). Again, regions along the NSEC gain more, but the positive economic effects spreads to a wider area beyond the corridor. However, compared to the case of EWEC, strong economic effects are more concentrated near the borders of China and Lao PDR. Bokeo (113.5%) in Lao PDR would gain most, followed by Yuxi (112.7%) and Licang (95.3%) in China, and Lamphun (94.5%) in Thailand. In terms of individual country gains, Myanmar gains the most (22.5%), followed by Lao PDR (19.1%) and Thailand (9.4%).

In recognition of the fact that a large number of regions and countries would be negatively affected, the total economic effect of NSEC is negative, -0.43%.

Figure 4-2-2. Economic effects of NSEC

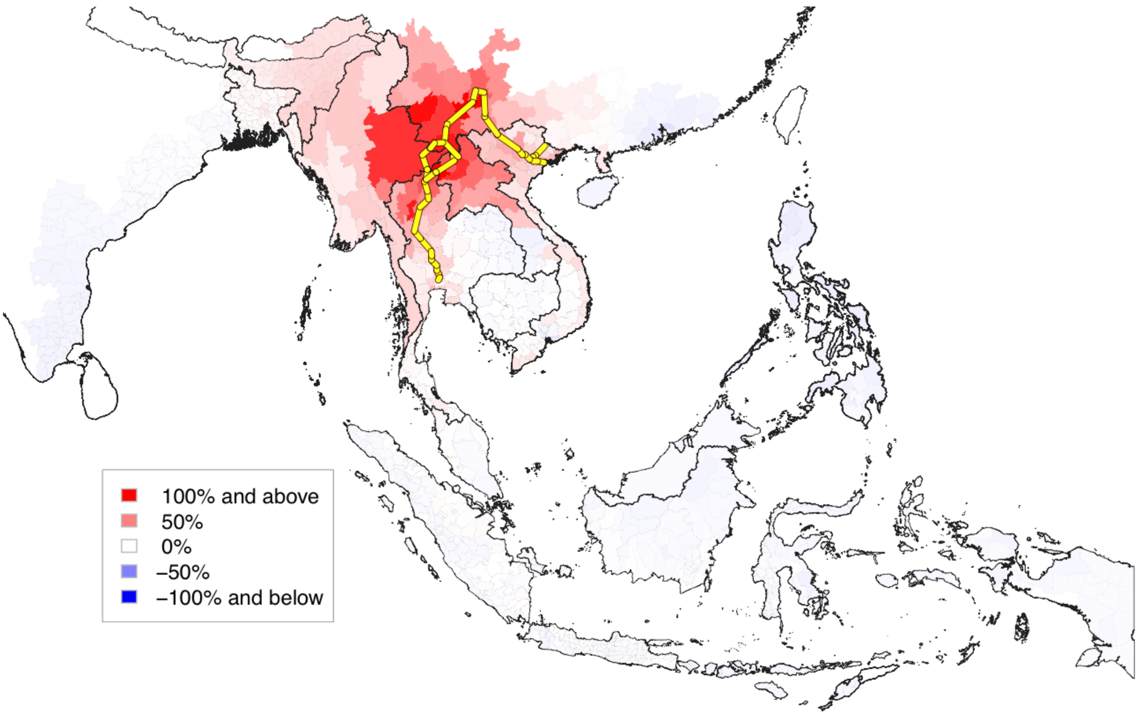


Table 4-2-2. Ranking of economic effects: NSEC

NSEC				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Bokeo	Laos	113.5%	Myanmar	22.5%
Yuxi	China	112.7%	Laos	19.1%
Lincang	China	95.3%	Thailand	9.4%
Lamphun	Thailand	94.5%	Bangladesh	4.0%
Xishuangbanna Dai	China	91.9%	Vietnam	3.1%
Oudomxai	Laos	84.3%	China	1.0%
Shan	Myanmar	82.0%	Malaysia	-0.6%
Simao	China	78.0%	India	-1.3%
Chiang Rai	Thailand	68.4%	Indonesia	-1.5%
Phongsali	Laos	67.1%	Cambodia	-2.2%
Number of regions with	100% or more	2	Singapore	-3.8%
	50% to 100%	14	Brunei	-4.2%
	0% to 50%	337	Philippines	-5.9%
	Less than 0%	603	Hong Kong	-9.8%
Total Economic Effect in 956 Regions		-0.43%	Macao	-9.8%

(3) Mekong India Economic Corridor (MIEC)

Figures 4-2-3a to 4-2-3c illustrate the economic effects of the Mekong-India Economic Corridor (MIEC), connecting Ho Chi Minh City, Phnom Penh, Bangkok, and Dawei by road, and further to Chennai (Madras) in India by sea route. MIEC is an extended version of the Southern Economic Corridor (SEC) as defined by ADB, with the objective of exploring more impacts by widening the scope of regional economic integration.

Compared to EWEC and NSEC, MIEC is more relevant to the conceptual framework of the CADP in the sense that it includes existing and emerging industrial agglomerations along the corridor, namely, Ho Chi Minh City, Bangkok, and Chennai. As discussed in Chapter 2, in order to pursue the deepening of economic integration and the narrowing of development gaps at the same time, it is important to utilize two opposite forces of globalization, namely, agglomeration forces and dispersion forces. In order to make this mechanism work effectively, an economic corridor should be designed to include regions at different development stages, that is, those with a different endowment of economic resources. In between the above mentioned industrial agglomerations, MIEC passes through lower-income regions such as Cambodia and Dawei in Myanmar. In this regard, MIEC is a good example to examine the validity of the conceptual framework of the CADP.

As often discussed, an economic corridor is only as strong as its weakest link. There still remains a lot to do to explore the full potential of MIEC by enhancing weak links. First of all, a long-awaited Mekong Bridge in Neak Loung (Cambodia) should be regarded as a top priority. Secondly, as it is being developed under bilateral cooperation between Thailand and Myanmar, it is important to open an effective means of access from Bangkok to the Andaman Sea, by upgrading the road connecting Kanchanaburi (Thailand) and Dawei (Myanmar). Thirdly, a comprehensive development project should be designed for Dawei, including a deep sea port and special economic zones. In particular, a deep sea port in Dawei will provide vast opportunities for the firms operating in the surrounding region by opening up a new logistics route to India, the Middle East, and Europe. In addition, this development is expected to reduce congestion in the Malacca Strait. All in all, the full spec MIEC can be regarded as a multimodal economic corridor, or a land bridge, passing through the Indochina Peninsular.

Let us take a closer, step-by-step look at the economic effects of MIEC. Figure 4-2-3a illustrates the impact of a bridge over the Mekong River in Neak Loung. Currently, in order to travel from Phnom Penh to Ho Chi Minh City along the Cambodian national road No.1, trucks have to make a stop at the Mekong River and take a ferry across the river. No matter how efficiently the ferry is operated, it is clearly much more time-consuming for trucks to make this crossing by ferry than it would be to use a bridge. The 10 regions which will benefit the most from the bridge are Cambodian regions such as Svay Rieng (2.49%), Prey Veng (2.33%), and Phnom Penh (2.06%). These are the regions along MIEC, i.e., national road No.5 in Cambodia. However, about half of the regions in Cambodia, those along and to the north of national road No.6, are expected to be negatively affected. The total economic effect in Cambodia is still positive, 1.104%.

Although the Mekong Bridge in Neak Loung can be developed as a national project in Cambodia, the economic effects would spread to neighboring countries. Vietnam and Lao PDR gain 0.097% and 0.063% respectively. In this scenario, the number of regions negatively affected is 298, much smaller than the 658 positively impacted regions. As a result, the total economic effect on the region as a whole is 0.014% greater than the level expected when considering the size of the development project. This implies that the lack of a bridge over the Mekong River in Neak Loung is in fact a significant bottleneck in ASEAN and surrounding regions, instead of being merely a bottleneck in Cambodia. All regions are connected through various transport links. Once a regional bottleneck is identified, it should be addressed as a regional initiative even when the bottleneck is wholly located in a specific country.

Figure 4-2-3b illustrates the economic effects of the second phase of MIEC, namely, an enhanced road connection from Ho Chi Minh City to Dawei. The overall benefits for the wider region are much greater if compared to the first phase. Taninthayi in Myanmar (247.7%) gains most, followed by Soc Trang (176.2%), Ca Mau (165.1%), and Bac Lieu (121.0%) in Vietnam, Samut Sakhon (109.3%) in Thailand and Phnom Penh (104.1%) in Cambodia. Under this scenario, Cambodia can expect to receive positive impacts on all regions in the country.

The economic effects at the national level are also significant; Cambodia (69.9%), Myanmar (59.0%), Vietnam (54.9%), and Thailand (24.7%). Although the positive impact on Vietnam as a whole is large, the impacts would be unevenly diffused. The northern part of Vietnam is expected to be negatively affected, at the expense of the significant gains made in the southern part of the country. Lao PDR gains as well, but the size of the impact is much smaller than in the case of EWEC and NSEC. The total economic effect in the regions under study is 4.31%, much larger than in the case of EWEC and NSEC.

Figure 4-2-3c illustrates the economic effects of the full specification of MIEC. The size of the impacts will be magnified further. Taninthayi in Myanmar, the region surrounding Dawei, gains most (272.9%), followed by Soc Trang (203.8%) and Ca Mau (191.5%) in the southern part of Vietnam. In terms of the benefits for individual countries, Cambodia gains most (76.5%), followed by Myanmar (66.0%), Vietnam (63.5%), Thailand (38.8%), and Lao PDR (14.5%). Regions in India under study are also expected to gain significantly.

On the other hand, Singapore is expected to be worse off (-3.5%) as a result of transport diversion effects. The development of MIEC would indeed reduce congestion in the Malacca Strait. Again, the impacts of infrastructure development would be diffused unevenly.

The total economic effect on the 956 regions under study is 7.82%, much larger than other scenarios such as EWEC and NSEC.

Figure 4-2-3a. Economic effects of MIEC (I): A Mekong bridge in Neak Loung

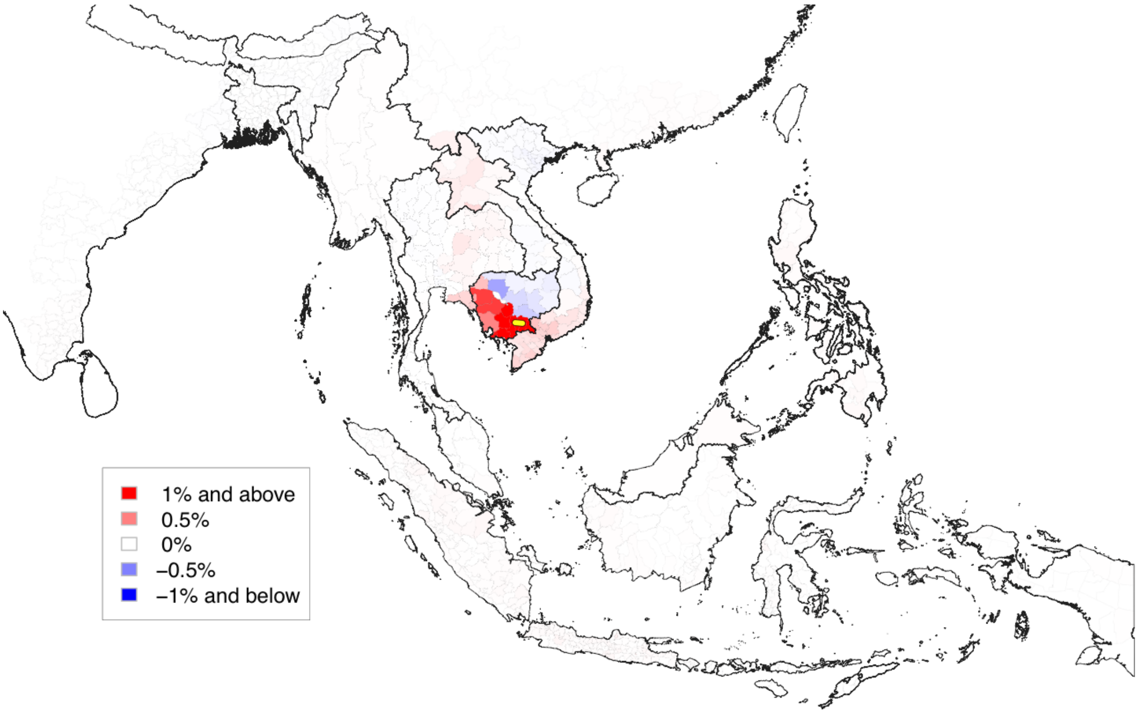


Table 4-2-3a. Ranking ofeconomic effects of MIEC (I)

MIEC(I)				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Svay Rieng	Cambodia	2.49%	Cambodia	1.104%
Prey Veng	Cambodia	2.33%	Vietnam	0.097%
Phnom Penh	Cambodia	2.06%	Lao PDR	0.063%
Kandal	Cambodia	1.83%	Philippines	0.013%
Kampong Chhnang	Cambodia	1.34%	Thailand	0.012%
Kampong Speu	Cambodia	1.25%	Indonesia	0.012%
Takeo	Cambodia	1.23%	China	0.006%
Kampot	Cambodia	1.07%	Brunei	0.006%
Sihanoukville	Cambodia	0.98%	Hong Kong	0.004%
Pursat	Cambodia	0.77%	Myanmar	0.004%
Number of regions with	100% or more	0	Macao	0.002%
	50% to 100%	0	Malaysia	0.002%
	0% to 50%	658	Singapore	0.001%
	Less than 0%	298	India	0.001%
Total Economic Effect in 956 Regions		0.014%	Bangladesh	0.000%

Figure 4-2-3b. Economic effects of MIEC (II): From Ho Chi Minh to Dawei

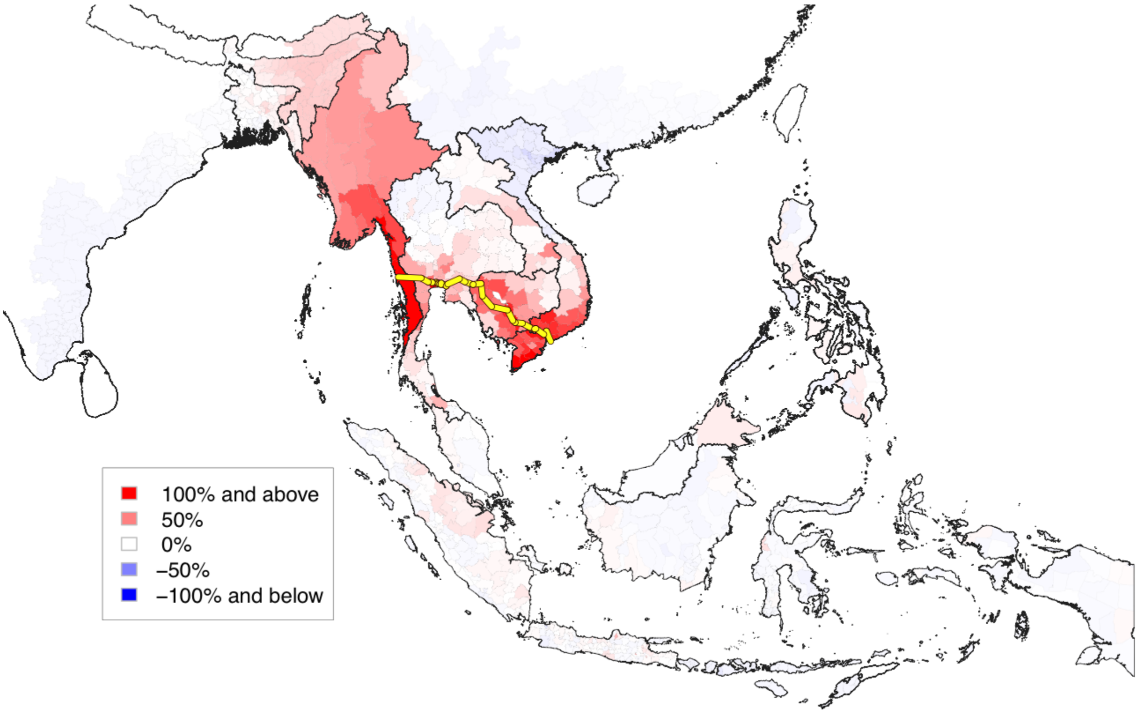


Table 4-2-3b. Ranking of economic effects: MIEC (II)

MIEC(II)				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Taninthayi	Myanmar	247.7%	Cambodia	69.9%
Soc Trang	Vietnam	176.2%	Myanmar	59.0%
Ca Mau	Vietnam	165.1%	Vietnam	54.9%
Bac Lieu	Vietnam	121.0%	Thailand	24.7%
Samut Sakhon	Thailand	109.3%	Lao PDR	5.2%
Phnom Penh	Cambodia	104.1%	Bangladesh	4.0%
Mon	Myanmar	101.3%	Philippines	0.8%
Long An	Vietnam	96.3%	Malaysia	0.3%
Ba Ria-Vung Tau	Vietnam	95.3%	Indonesia	0.1%
Kandal	Cambodia	92.8%	India	-0.9%
Number of regions with	100% or more	7	China	-2.0%
	50% to 100%	36	Brunei	-2.7%
	0% to 50%	372	Hong Kong	-3.1%
	Less than 0%	541	Macao	-3.2%
Total Economic Effect in 956 Regions		4.31%	Singapore	-3.6%

Figure 4-2-3c. Economic effects of MIEC (III): Full spec

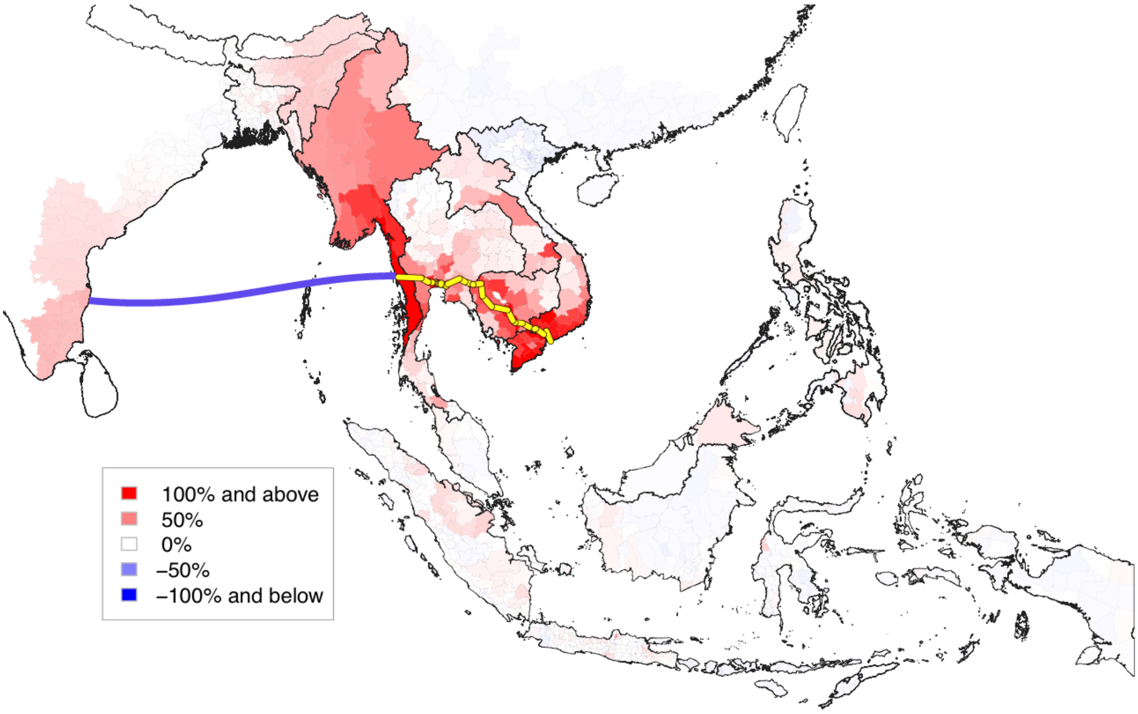


Table 4-2-3c. Ranking of economic effects: MIEC (III)

MIEC(III)				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Tanintharyi	Myanmar	272.9%	Cambodia	76.5%
Soc Trang	Vietnam	203.8%	Myanmar	66.0%
Ca Mau	Vietnam	191.5%	Vietnam	63.5%
Samut Sakhon	Thailand	157.8%	Thailand	38.8%
Bac Lieu	Vietnam	140.2%	Lao PDR	14.5%
Mon	Myanmar	114.8%	India	13.4%
Phnom Penh	Cambodia	112.0%	Bangladesh	4.6%
Long An	Vietnam	109.1%	Philippines	1.7%
Ba Ria-Vung Tau	Vietnam	105.6%	Indonesia	0.8%
Binh Phuoc	Vietnam	104.3%	Malaysia	0.4%
Number of regions with	100% or more	11	China	-2.0%
	50% to 100%	41	Brunei	-2.5%
	0% to 50%	488	Hong Kong	-2.9%
	Less than 0%	416	Macao	-3.3%
Total Economic Effect in 956 Regions		7.82%	Singapore	-3.5%

(4) Three Economic Corridors in Indochina Peninsular (3ECs)

Figure 4-2-4 illustrates the economic effects of three economic corridors in the Indochina Peninsular, EWEC, NSEC, and MIEC.

Although the total economic effect on the whole region is significant (6.24%), the size of the impacts is smaller than in the case of MIEC alone. This is because some of the economic effects of a specific economic corridor can be cancelled out by other economic corridors. Considering the expense of implementing the scenarios under consideration, “doing everything” is not always the best strategy. Rather, it is important to design a grand spatial plan of infrastructure development taking due account of concentration on weak links in the region.

Figure 4-2-4. Economic effects of 3ECs

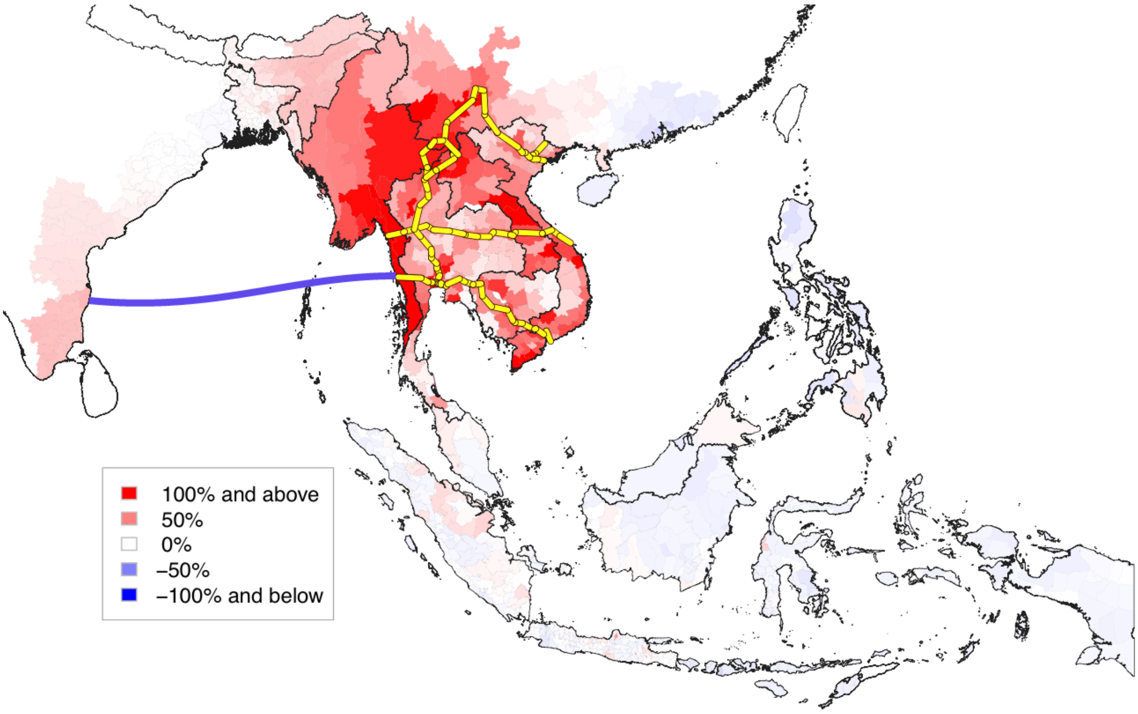


Table 4-2-4. Ranking of economic effects: 3ECs

3ECs				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Taninthayi	Myanmar	250.0%	Myanmar	82.1%
Khammouan	Laos	195.6%	Cambodia	54.7%
Samut Sakhon	Thailand	194.1%	Lao PDR	50.9%
Soc Trang	Vietnam	176.9%	Thailand	49.6%
Ca Mau	Vietnam	166.5%	Vietnam	49.3%
Xekong	Laos	163.6%	India	12.8%
Mon	Myanmar	142.6%	Bangladesh	7.3%
Lamphun	Thailand	129.9%	Malaysia	1.1%
Bokeo	Laos	127.5%	China	-1.9%
Bolikhamxai	Laos	120.0%	Indonesia	-2.1%
Number of regions with	100% or more	16	Philippines	-6.4%
	50% to 100%	66	Singapore	-7.8%
	0% to 50%	428	Brunei	-8.1%
	Less than 0%	446	Hong Kong	-13.9%
Total Economic Effects in 956 Regions		6.24%	Macao	-14.4%

(5) IMT+

Figure 4-2-5 illustrates the economic effect of the IMT+ corridor[2]. As shown in the Figure 4-2-5 and Table 4-2-5, Sumatra Island benefits very significantly under this scenario through better access to relatively richer regions in Malaysia and Thailand.

The top 10 gainers are all regions in Indonesia, namely, Kota Lholseumawe (470.6%), Kota Pematang (328.3%), Siak (325.3%), Asahan (323.3%), and Kota Medan (321.5%). However, considering its geographical size and nature as an archipelagic country, the total economic effect on Indonesia as a whole is rather moderate, 20.1%. In terms of the economic effect at the national level, Malaysia gains most, 38.6%, followed by Myanmar (21.1%).

The total economic effect in all regions under study is 16.24%, much larger than that under the scenarios of economic corridors in the Indochina Peninsular. Most notably, the economic effect of the IMT+ corridor is expected to spread more evenly than the three corridors in the Indochina Peninsular. Indeed, all countries under study will be better off from this scenario as shown in Table 4-2-5. The number of regions negatively affected by this scenario is only 36 out of 956. This is because all ports in the region are, in effect, connected to sea routes. Therefore, enhancement in sea routes can have greater impacts as compared to enhancement in road infrastructure.

[2] "IMT+" is a concept of sub-region, wider than the Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT), in the sense that it considers the connections with neighboring industrial agglomerations such as Bangkok and Jakarta.

Figure 4-2-5. Economic effects of IMT+ corridor

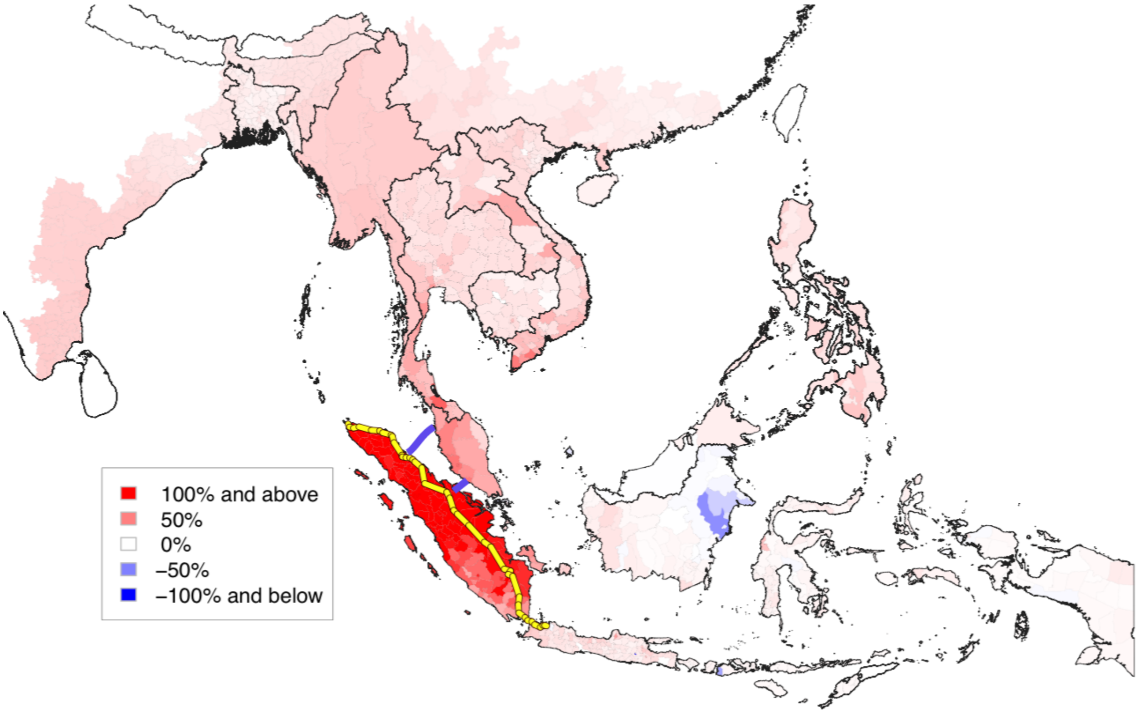


Table 4-2-5. Ranking of economic effects: IMT+ corridor

IMT+				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Kota Lhokseumawe	Indonesia	470.6%	Malaysia	38.6%
Kota Pematang Siantar	Indonesia	328.3%	Myanmar	21.1%
Siak	Indonesia	325.3%	Indonesia	20.1%
Asahan	Indonesia	323.3%	Thailand	19.3%
Kota Medan	Indonesia	321.5%	Vietnam	19.3%
Kota Tanjungbalai	Indonesia	298.6%	Lao PDR	17.6%
Kota Binjai	Indonesia	297.4%	Singapore	17.3%
Rokanhilir	Indonesia	286.9%	India	16.2%
Deli Serdang	Indonesia	282.7%	Cambodia	15.7%
Bengkalis	Indonesia	282.4%	Philippines	12.0%
Number of regions with	100% or more	75	Hong Kong	11.1%
	50% to 100%	42	Macao	10.5%
	0% to 50%	803	China	8.4%
	Less than 0%	36	Bangladesh	7.4%
Total Economic Effects in 956 Regions		16.24%	Brunei	4.3%

(6) BIMP+ (Ring Route)

Figure 4-2-6 illustrates the economic effect of the BIMP+ (Ring) corridor[3]. The economic effect is quite significant, amounting to 30.52%. In particular, regions in Sulawesi Island are expected to gain significantly. Again, the top 10 gainers are all regions in Indonesia, namely, Kota Kediri (655.5%), Mamuju Utara (417.2%), Kota Bitung (370.2%), Kota Makasar (361.2%), and Kudus (292.7%). Sulawesi Island, Kota Makasar in particular, is expected to function as the core of economic development in Eastern Indonesia and narrow the development gaps in Indonesia. In this respect, it is important to first promote the economic development of Sulawesi Island, by opening up effective access to neighboring regions. Even though the economy of Sulawesi Island is dominated by the primary sector, better access to large markets is expected to open a new perspective of development strategy in the region

In addition, regions in Mindanao Island in the Philippines gains significantly, namely, Region XII, Soccsksargen (210.9%), Region X, Northern Mindanao (140.6%), and Region XIII, Caraga (105.1%). This will also provide an opportunity to narrow the development gaps in the Philippines.

Similar to IMT+, the economic effect of the BIMP+ (Ring) corridor is expected to be diffused more evenly. All countries are better off, and the number of regions affected negatively is only 9 out of 956.

[3] "BIMP+" is a concept of sub-region, wider than the Brunei Darussalam-Indonesia-Malaysia-the Philippines East ASEAN Growth Area (BIMP-EAGA), in the sense that it considers the connections with neighboring industrial agglomerations such as Singapore, Jakarta, Surabaya and Manila.

Figure 4-2-6. Economic effects of BIMP+(Ring) corridor

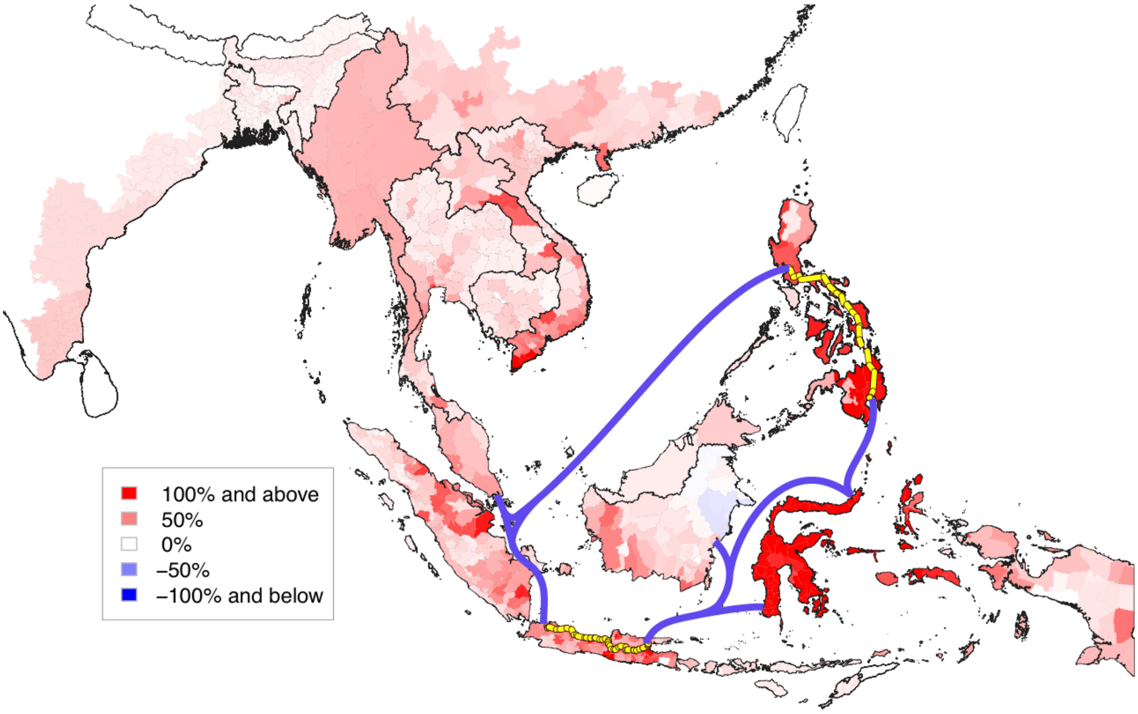


Table 4-2-6. Ranking of economic effects: BIMP+(Ring) corridor

BIMP+ (Ring Route)				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Kota Kediri	Indonesia	655.5%	Indonesia	65.7%
Mamuju Utara	Indonesia	417.2%	Philippines	63.4%
Kota Bitung	Indonesia	370.2%	Vietnam	38.7%
Kota Makasar	Indonesia	361.4%	Myanmar	30.6%
Kudus	Indonesia	292.7%	Malaysia	28.1%
Minahasa Selatan	Indonesia	232.8%	Thailand	23.6%
Minahasa	Indonesia	230.1%	Lao PDR	22.5%
Bonebolango	Indonesia	223.7%	Singapore	18.7%
Kota Palu	Indonesia	214.9%	China	18.6%
Kota Kendari	Indonesia	212.9%	Cambodia	18.2%
Number of regions with	100% or more	79	India	13.9%
	50% to 100%	104	Hong Kong	10.7%
	0% to 50%	764	Macao	8.0%
	Less than 0%	9	Bangladesh	6.9%
Total Economic Effects in 956 Regions		30.52%	Brunei	5.8%

(7) All corridors

Figure 4-2-7 illustrates the economic effect of all corridors we have considered so far, namely, EWEC, NSEC, MIEC, IMT+, and BIMP+. The total economic effect is magnified further to 54.77%.

In terms of the benefits for individual countries, Myanmar gains the most (145.8%), followed by Vietnam (114.6%), Lao PDR (99.3%), Thailand (98.6%), Cambodia (97.9%), Indonesia (85.0%), the Philippines (73.4%), and Malaysia (64.4%). The most important point to note here is that, except for Thailand, the size of the positive impact is expected to be larger in lower-income countries. This finding can be regarded as supporting evidence to claim that these economic corridors can contribute to the narrowing of development gaps.

Most of the regions benefit significantly. 254 regions out of 956 will gain more than 100%, and 239 regions gain between 50% and 100%. The number of regions affected negatively is only 17, mainly those in East Kalimantan and some parts of Papua province. These regions have mining-based economies, which have higher GDP in the baseline scenario. The improvement of the infrastructure in other parts of Indonesia reduces some inflow of labor from these mining-based economies, leading to the slightly decreased regional GDP compared with the baseline scenario.

Figure 4-2-7. Economic effects of all corridors

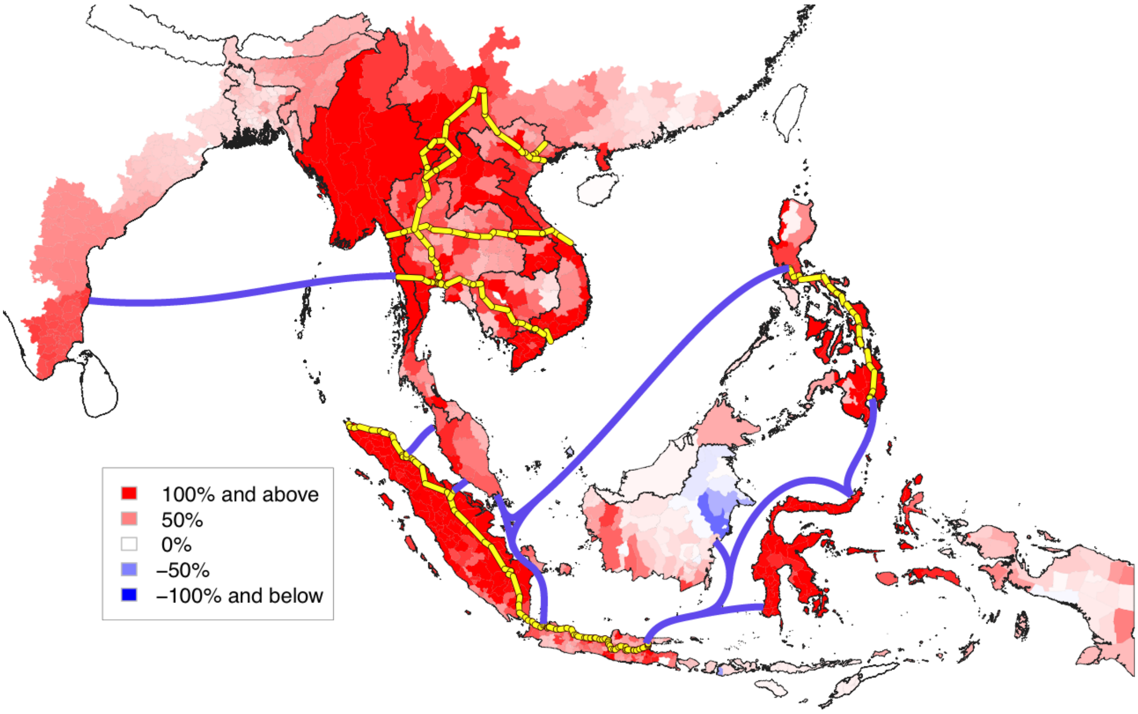


Table 4-2-7. Ranking of economic effects: All corridors

All				
Ranking by Region			Ranking by Country	
Region	Country	Economic Effects	Country	Economic Effects
Kota Lhokseumawe	Indonesia	533.7%	Myanmar	145.8%
Asahan	Indonesia	485.8%	Vietnam	114.6%
Mamuju Utara	Indonesia	480.8%	Laos	99.3%
Kota Pematang Siantar	Indonesia	463.4%	Thailand	98.6%
Rokanhilir	Indonesia	432.8%	Cambodia	97.9%
Indragiri Hilir	Indonesia	419.2%	Indonesia	85.0%
Kota Binjai	Indonesia	411.4%	Philippines	73.4%
Kota Kediri	Indonesia	410.3%	Malaysia	64.4%
Kota Tanjungbalai	Indonesia	408.1%	India	45.6%
Soc Trang	Vietnam	404.4%	Singapore	29.2%
Number of regions with	100% or more	254	China	25.4%
	50% to 100%	239	Bangladesh	23.0%
	0% to 50%	446	Hong Kong	8.2%
	Less than 0%	17	Macao	4.1%
Total Economic Effects in 956 Regions		54.77%	Brunei	2.7%

4-3. Overall assessment

Table 4-3-1 shows a summary of simulation results, focusing on the economic effects in terms of economic growth and the contribution to the narrowing of development gaps.

The second column shows the change in the average annual growth rate for a 10-year period from 2010 to 2020 under each scenario, as compared to that under the baseline scenario. Although all scenarios are expected to lead to higher economic growth, the size of the impacts differs significantly by scenario. Among the three corridors in the Indochina Peninsular, MIEC has the largest impact on growth rates.

An all-corridor scenario leads to the highest economic growth (0.72%). As a result, the sum of regional GDP under this scenario in 2020 is 7.08% more than that under the baseline scenario. At the same time, inequality in the whole region under study, as measured by the Gini coefficient, is reduced by 0.63% as compared to the baseline scenario.

Table 4-3-1. Growth and NDG Impacts of Major Corridors

	Growth Impact		NDG Impact
	Change in Average Annual Growth Rate: 2010-2020	% Difference in RGDP in 2020	% Change in Gini Coefficient
EWEC	0.03 point	0.32%	-0.07%
NSEC	0.01 point	0.14%	-0.13%
MIEC(III)	0.13 point	1.19%	-0.23%
3 Corridors	0.13 point	1.23%	-0.38%
IMT+	0.11 point	1.08%	-0.25%
BIMP+	0.45 point	4.31%	0.08%
All Corridors	**0.72 point**	**7.08%**	**-0.63%**