Chapter 11

Long-run Economic Impacts of Thai Flooding: Geographical Simulation Analysis

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CHAPTER 11

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We discuss the long-run economic impact of natural disasters on the countries concerned by examining the case of Thai flooding in 2011. If the damage caused by disasters is really serious, industries will move out from the countries in question, and this outflow leads to a negative impact on the national economies in the long run. By using IDE/ERIA-GSM and utilizing short-run forecast for the basic setting, we estimate the seriousness of the flooding in terms of the long-term economic performance. Simulation results show that negative long-run impacts of the flood will be moderate, because many companies' first reaction to the flood was to seek possible relocation of their production sites within Thailand.

***Keywords*:** Thailand, Flood, New economic geography, Computable general equilibrium models, Disaster management

1. Introduction

After the Great East Japan Earthquake and the flooding in Thailand in 2011, many media reported interruptions in production networks, or even in manufacturing industries in Japan and Thailand as a whole. Disruption of one factory in a value chain may lead to the halt of the total production and sales chains, and the media claimed that the vulnerability in production networks must be a serious risk to Japan and Thailand. However, as Ando (2012) pointed out, production networks have recovered very quickly and have showed resiliency of the value chain, because the value chain itself has a strong self-recovering function from disconnection.

This chapter discusses another aspect of the economic impacts of disasters, that is, the long-term economic impact of natural disasters on the countries concerned. If the damage caused by disasters is really serious, industries will move out from the countries in question, and the outflow of economic activities may cause a negative impact on the national economies in the long run. By using IDE/ERIA-GSM, we can estimate the seriousness of the disasters in terms of the long-term economic performance.

IDE/ERIA-GSM is a simulation model based on spatial economics, which is also known as new economic geography. The model is used as a tool for policy makers to judge what sorts of trade and transport measures (TTFMs) must be taken care of, how to prioritize them and how to combine them. It can also simulate possible negative impacts of disasters in the long run. The model consists of an original microeconomic model with a general equilibrium setting, original simulation programs, a huge dataset including 1,654 regions, 3,156 nodes and 5,029 routes, and several parameters obtained by econometric estimations. It covers 16 countries/economies in Asia and two non-Asian economies, namely; Bangladesh, Brunei Darussalam, Cambodia, China, Hong Kong, India, Indonesia, Japan, Lao PDR, Macao, Myanmar, Malaysia, the Philippines, Singapore, Thailand, Vietnam, the United States and the European Union (EU). The model provided theoretical foundation for the prioritization of infrastructure projects in the Comprehensive Asia Development Plan (CADP) and was also referred to in the Master Plan on ASEAN

Connectivity (MPAC) report (ERIA, 2010 and ASEAN, 2010).

We adopt the same methodology as Isono and Kimura (2011) to estimate the economic impacts of the 2011 flooding in Thailand. Isono and Kimura (2011) assessed the economic effects of the Great East Japan Earthquake and concluded that the earthquake might cause a shift of industrial structure from the east to the west of Japan, and to China and other East Asian counties. It claimed that further enhancement of the linkages between Japan and East Asia could mitigate this shift and for Fukushima, Miyagi and Iwate prefectures, tighter connections between Sendai Airport and Okinawa's logistics hub would positively stimulate electronics industries in the Tohoku area.

In addition to adopting the methodology in Isono and Kimura (2011), we reinforced our base settings with using the Current Quarter Model (CQM) by Kumasaka (forthcoming). By applying this short-run forecast as of December 2011 for the GSM, we can obtain a rough image of the magnitude of the damage to Thailand at a very early stage following the disaster. We here estimate long-run impacts and claim that these long-run impacts would be moderate, because many companies' first reaction to the flood is to seek possible relocation of their production sites within Thailand. In fact, simulation results reveal that, at the national level, some provinces in Thailand experiencing positive economic impacts following the flood, would mitigate the negative impacts on the affected provinces. At the time of writing, observations and surveys on the ground in Thailand report that some companies, including multinational enterprises, are relocating from the affected areas to safer provinces in Thailand, which clearly supports our estimations.

This chapter is structured as follows: Section 2 gives a brief explanation of the model. Section 3 provides the baseline scenario, the flooding scenario and alternative scenarios concerning recovery from the flood by enhancing connectivity. Section 4 concludes with some policy implications.

2. Simulation Model

2.1. Basic Structure of Our Simulation Model[1]

In our economic model, there are 1,654 locations, indexed by *r* in 18 countries/economies. There are two productive factors: labor and arable land. Labor is mobile within a country but stays immobile across countries.

Consumer preferences, which are identical across the world, are described by a Cobb-Douglas consumption function for an agricultural product, a manufacturing aggregate and a services aggregate. The manufacturing aggregate and services aggregate are expressed by a constant elasticity of substitution (CES) consumption function for individual manufactured goods or services. There are three sectors: agriculture, manufacturing, and services, and the manufacturing sector is divided into 5 sub-sectors; automobile, electronics and electrical appliances, garment and textile, food processing and other manufacturing. The agricultural sector produces a single and homogeneous agricultural product from arable land and labor, using a constant-returns technology under perfect competition. Manufacturing firms produce differentiated products using an increasing-returns technology under monopolistic competition where they use their labor forces and intermediate goods as inputs. Manufacturing intermediaries are procured from all manufacturing firms. Services are produced with using an increasing-returns technology under conditions of monopolistic competition where they use labor only. Economies of scale arise at factory levels. Labor can move to the sectors that offer higher nominal wage rates within the region.

All products in the three sectors are tradable. Transport for an agricultural good is assumed to be costless. Note that the price of an agricultural good is chosen as the numeraire so that the price of the good is unitary across regions. Transport costs for manufactured goods and services are supposed to be of the iceberg type. An increase in purchaser's price compared to the manufacturer's price is regarded as the transport cost. Transport costs within a region are considered to be negligible.

[1] This section is excerpted and modified from Kumagai, *et al.* (forthcoming)

2.2. Parameters

We have a number of critical parameters in the model. The consumption share of consumers by industry is uniformly determined for the entire region in the model (Table 1).

Table1: Consumption Share by Industry

	Consumption Share
Agriculture	0.1623
Automotive	0.0092
E&E	0.0439
Garment &Textile	0.0428
Food Processing	0.0348
Other Manufacturing	0.1541
Services	0.5529

Source: Authors.

The labor input share for each industry is uniformly determined for the entire region in the model, according to that of Thailand in the year 2000, taken from the International Input Output Table by IDE-JETRO (Table 2). Because the simulation is run for more than 20 years, however, it may not be realistic to fix the labor input share for such a long period of time, especially for a developing country. However, we do not have a method to change the share with confidence. We therefore decided to use an "average" value, in this case that of Thailand as a country at the middle-stage of economic development.

Table 2: Labor Input Share by Industry

	Labor Input Share
Agriculture	0.633
Automotive	0.621
E&E	0.633
Garments& Textile	0.654
Food Processing	0.796
Other Manufacturing	0.733
Services	1.000

Source: Authors.

We adopt the elasticity of substitution for manufacturing sectors from Hummels (1999) and estimate that for services as follows: 5.1 for Food, 8.4 for Textile, 8.8 for

Electronics, 7.1 for Transport, 5.3 for Other Manufacturing, and 5.0 for Services. The estimates for the elasticity for services are obtained from the estimation of the usual gravity equation for services trade, including importer's GDP, exporter's GDP, importer's corporate tax, geographical distance between countries, a dummy for free trade agreement, a linguistic commonality dummy, and the colonial dummy as independent variables.

For the transport costs, we first estimate the multinomial logit model of firms' behavior in shipping their products by using firm-level data, based on the Establishment Survey on Innovation and Production Network (Intarakumnerd, 2010). Next, we estimate some parameters such as holding time across borders. By employing these estimates in addition to the multinomial logit results, we specify a transport cost as a function for calculating the transport costs between regions. After that, we estimate Policy and Cultural Barriers (PCBs). Finally, we derive the transport costs between regions to be used in the simulation. Specifically, the transport cost in industry *s* by mode *M* between regions *i* and *j* is assumed as

$$C_{ij}^{s,M} = \underbrace{\left[\left(\frac{dist_{ij}}{Speed_M}\right) + \left(1 - Abroad_{ij}\right) \times ttrans_M^{Dom} + Abroad_{ij} \times ttrans_M^{Intl}\right]}_{Total\ \ Transport\ \ Time} \times ctime_s$$
$$+ \underbrace{dist_{ij} \times cdist_M}_{Physical\ \ Transport\ \ Cost} + \underbrace{\left(1 - Abroad_{ij}\right) \times ctrans_M^{Dom} + Abroad_{ij} \times ctrans_M^{Intl}}_{Physical\ \ Transshipment\ \ Cost}$$

where $dist_{ij}$ is the travel distance between regions *i* and *j*, $Speed_M$ is travel speed per one hour by mode *M*, $cdist_M$ is physical travel cost per one kilometer by mode *M*, and $ctime_s$ is time cost per one hour perceived by firms in industry *s*. The parameters $ttrans_M^{Dom}$ and $ctrans_M^{Dom}$ are the holding time and cost, respectively, for domestic transshipment at ports or airports. Similarly, $ttrans_M^{Intl}$ and $ctrans_M^{Intl}$ are the holding time and cost, respectively, for international transshipment at borders, ports, or airports. The parameters in the transport function are determined by estimation and adaptation from the ASEAN Logistics Network Map 2008 by JETRO, as shown in Table 3 (JETRO, 2008 and 2009). $Abroad_{ij}$ is a dummy taking a value of one if the transaction is international while zero if domestic.

Table 3: Parameters from Estimation and ASEAN Logistics Network Map 2008

	Truck	Sea	Air	Unit	Source
$cdist_M$	1	0.24	45.2	US$/km	Map
$Speed_M$	38.5	14.7	800	km/hour	Estimation
$ttrans_M^{Dom}$	0	11.671	9.01	hours	Estimation
$ttrans_M^{Intl}$	13.224	14.972	12.813	hours	Estimation& Map
$ctrans_M^{Dom}$	0	190	690	US$	Map
$ctrans_M^{Intl}$	500	504.2	1380.1	US$	Estimation& Map

	Food	Textile	Machineries	Automobile	Others
$ctime_s$	15.7	17.2	1803.3	16.9	16.5

Notes: Costs are for a 20-foot container. The parameter $ctrans_M^{Dom}$ is assumed to be half of the sum of border costs and transshipment costs in international transport from Bangkok to Hanoi. The parameters $ttrans_M^{Dom}$ and $ctrans_M^{Dom}$ for sea and air include one-time loading at the origin and one-time unloading at the destination.

Source: Authors' calculation.

In addition, $ttrans^{Dom}$ and speed of railway are estimated by the same dataset and the same estimating equation. Due to the minimal usage of railways in international transactions in the dataset, we adopted the same value for the time and cost of international transactions as in trucks from Table 3. Finally, we set the cost per km as half the value of road transport (Table 4).[2]

Table 4: Parameters for Rail Transport

	Railway	Unit	Source
$cdist_M$	0.5	US$/km	Half of Truck
$Speed_M$	19.1	km/hour	Estimation
$ttrans_M^{Dom}$	2.733	hours	Estimation
$ttrans_M^{Intl}$	13.224	hours	Same as Truck
$ctrans_M^{Intl}$	500	US$	Same as Truck

Source: Authors' calculation.

We use the estimated values as a general rule and additionally set the speed of land, sea, air and rail transport of each section differently from the data from UNESCAP and other various institutions, reflecting the gaps of the quality of

[2] The ASEAN Logistics Network Map 2008 offers an example where the cost per km for railway is 0.85 times that of trucks. However, this is only the case when we ship a quantity that can be loaded onto a truck. Railways have much greater economies of scale than trucks in terms of shipping volume, so some industries such as coal haulage incur much lower cost per ton-kilometer. Therefore, we need to deduct this from the value in the ASEAN Logistics Network Map 2008.

infrastructure and the frequency of transport modes. For example, we assume most land trunk routes in Thailand can be run at 60km/h, while some mountainous routes or poor roads can be run at only 19km/h.

So far, we have estimated several components of transport costs including cost for transportation time, cost for transshipment time (holding time), physical transport cost, and physical transshipment cost. These costs are collectively called "GSM transport cost" in this subsection. However, some important components of the broadly defined "transport costs" remain excluded in the model. Examples include tariffs, non-tariff trade barriers (e.g. quota restrictions), procedures before shipping, costs arising from political situations or from certain risks, cost arising from preference differences and cost arising from commercial customs differences. We call these collectively "Policy and Cultural Barriers" (PCBs). We employ the "log odds ratio approach", as initiated by Head and Mayer (2000), in order to avoid the problem of data availability in the estimation of the model, similar to our GSM model. We first estimate the values for Thailand, the Philippines, Malaysia, and Indonesia by using per capita GDP data from the World Development Indicator (World Bank) and input-output data from the Asian International Input-Output Table published by the Institute of Developing Economies, JETRO (IDE-JETRO). We regress days for customs clearance in importing (Days), for which data are drawn from the "Doing Business Indicator" from the World Bank, to get the other sample countries' PCBs. As a result, tariff equivalents of PCBs in the other GSM countries are provided as in Tables 5 and 6.

Table 5: Tariff Equivalents of PCBs (%)

	Food	Textile	Machinery	Automobile	Others
Indonesia	162.9	42.2	105.0	326.0	189.4
Malaysia	108.6	18.6	69.4	202.0	108.5
Philippines	127.9	27.1	82.2	244.5	136.3
Thailand	144.6	34.4	93.2	282.6	161.2

Source: Authors' estimation.

Table 6: Tariff Equivalents of PCBs for the Remaining Countries (%)

	Food	Textile	Machinery	Automobile	Others
Bangladesh	184.7	51.3	118.9	379.5	223.9
Brunei	132.3	29.1	85.1	254.4	142.8
Cambodia	188.6	52.9	121.4	389.5	230.4
China	152.2	37.6	98.1	300.5	172.8
Hong Kong	123.4	25.2	79.3	234.3	129.7
India	204.5	59.5	131.4	430.1	256.5
Japan	91.7	11.0	58.0	166.2	84.8
Korea	97.6	13.7	62.0	178.6	93.0
Laos	185.9	51.8	119.7	382.6	225.9
Myanmar	207.9	60.9	133.5	438.9	262.1
Singapore	34.2	0.0	17.8	56.7	11.5
Vietnam	148.5	36.0	95.7	291.7	167.1

Source: Authors' estimation.

We are then able to obtain the transport costs between regions, by industry, to be used in the simulation, using the transport cost function, several parameters, and PCBs. Firstly, we choose the economically shortest routes between regions by industry, adopting the transport cost function to all possible routes between regions. The shortest routes and utilized modes may differ among industries, even in the same regional pairs. Next, we calculate the transport costs between regions by industry. This cost is defined as the monetary cost when shipping products using a 20-foot container. Due to the fact that transport costs in this simulation are the ratio associated with the value of products being shipped, we need to transform the costs to fit into the simulation. Except for the electronics and electrical appliance industry, we adopt the average values in a 20-foot container from the preliminary survey results of the FY2010 ERIA-GSM Project, as in Table 7. In the case of the electronics and electric appliance industry, we assumed that firms ship 2 tons per 20-foot container. The value in 20-foot container for the electronics and electric appliance industries is calculated independently as USD 376,611 based on the trade value and volume data in Thailand. The reason why we adopt another value for those industries is the fact that some electronics firms answered in the survey that they selected mainly air transport, and that they did not utilize containers. This implies the existence of a sample selection bias in this survey for those industries. Finally, we transform the transport costs associated with the value of the products.

PCBs are multiplied by the factors as in Tables 5 and 6 when the products are imported to corresponding countries.

Table 7: Average Value in 20-foot Container (USD)

	# of Sample	Average Value
Automobile	6	89,691
E & E	11	92,746
Garment and Textile	10	34,560
Agro and Food processing	9	37,233
Others	8	59,450
Total	44	

Source: Preliminary survey results of FY2010 ERIA-GSM Project.

Wage equations in the model include the variable A, which represents technology, or the productivity of each region, and is set by industry. A is calibrated at the beginning of the simulation to match the expected wage rate from the wage equation and the actual wage rate. It is a kind of "residual," including everything that affects the wage level, other than the variables explicitly included in the wage equation.

The parameters for labor mobility are set out at three levels, namely, international labor mobility (γ_N), intranational (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 twice as high real wages as the average attracts 10% labor inflow per year.

We set γ_N =0. This means that the international migration of labor is prohibited. Although this looks like a rather extreme assumption, it is reasonable enough, taking into account the fact that most ASEAN countries strictly control incoming foreign labor.

We set γ_C =0.02. This means that a region with twice as high real wages as the national average induces 2 percent labor inflow a year.

Finally, we set γ_I =0.05, too. This means that an industrial sector with twice as high real wages as the average in the region induces 5 % labor inflow from other industrial sectors per year.

We assume exogenous population growth, given the predicted rate of population growth provided by the United Nation Population Division (Table 8).

Table 8: Expected Population Growth Rate (2005-2030)

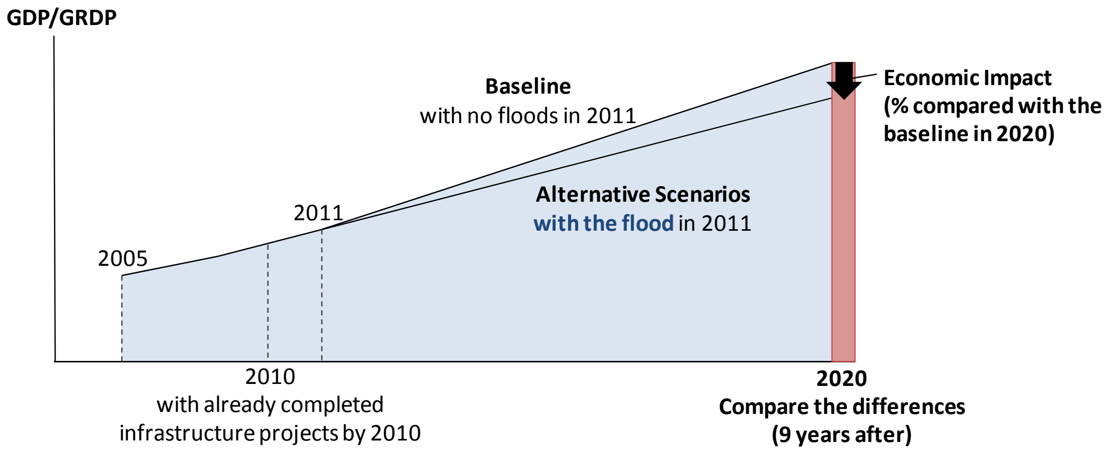
Malaysia	1.47%	China	0.51%
Thailand	0.49%	Hong Kong	0.56%
Singapore	0.92%	Macao	0.84%
Cambodia	1.69%	India	1.29%
Lao PDR	1.56%	Bangladesh	1.80%
Myanmar	0.74%	Indonesia	1.00%
Vietnam	1.18%	Philippines	1.66%
Brunei	1.74%		

Source: United Nation Population Division.

3. Baseline Scenario, Flood Scenario and Recovery Scenarios

In this section, we provide simulation results based on the settings and assumptions in the last section. The relationships between scenarios in terms of economic impacts are shown in Figure 1. Every simulation starts from 2005. We assume that there were some infrastructure projects completed by 2010. In the baseline scenario, we do not assume additional damage or infrastructure development and run a simulation toward 2020. In the alternative scenario of flooding in Thailand, we assume damage to production in 2011 and recovery in 2012, and run a simulation up to 2020. We compare the economic situations between the baseline scenario and the alternative scenario in 2020 and derive the economic impact of the flooding as a difference between the two scenarios. We also conduct various simulations to identify effective recovery measures, assuming various physical and institutional connectivity enhancements in addition to the damage caused by the flood.

Figure 1: Baseline Scenario and Alternative Scenarios.



Source: Authors.

3.1. Flood Scenario

First we set the flood scenario (Scenario 0). We assume that local infrastructure including the production infrastructure of the factories in affected provinces were damaged in 2011 and recovered in 2012. We describe the situation by lowering the technological parameter A in 2011 and restoring it in 2012. Parameter A includes elements as follows:

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

To set the magnitude of the damage, we use CQM of Thailand by Kumasaka (forthcoming). CQM, updating estimations by an ARIMA type analysis from various partially available information, can estimate very short run impacts of economic shocks to production or GDP. It can provide estimated values before actual official reports are released. As of December 22, 2011, CQM estimated the impacts on real and nominal GDP values in Q4 in 2011 as in Table 9, where we had no official reports on GDP yet.

Table 9:CQM Short-run Forecasts on GDP of Thailand

Real	SR1000	SR010	SR020	SR030	SR040	SR050	SR060	SR070	SR080	SR090	SR100	SR110	SR540
2011Q1	7.52	47.89	-0.08	5.68	1.63	-16.67	1.31	14.57	4.23	16.18	13.05	-11.21	3.37
2011Q2	0.19	-1.04	-14.39	0.24	-9.31	-13.22	-0.64	-0.12	5.87	16.89	2.56	-7.60	2.42
2011Q3	2.14	-30.54	-13.13	7.22	20.92	-1.05	6.71	3.85	1.40	17.17	1.18	1.53	1.08
2011Q4	-21.38	1.48	8.82	-40.80	-10.38	-11.24	1.73	-27.85	-28.62	6.05	4.12	11.27	6.00
2012Q1	2.32	21.26	3.59	-2.76	4.40	-2.82	2.58	-7.28	10.28	4.21	1.76	4.23	2.03
2012Q2	4.70	0.38	3.32	10.43	4.77	-2.19	-1.81	6.76	-5.12	12.83	4.13	6.10	3.01

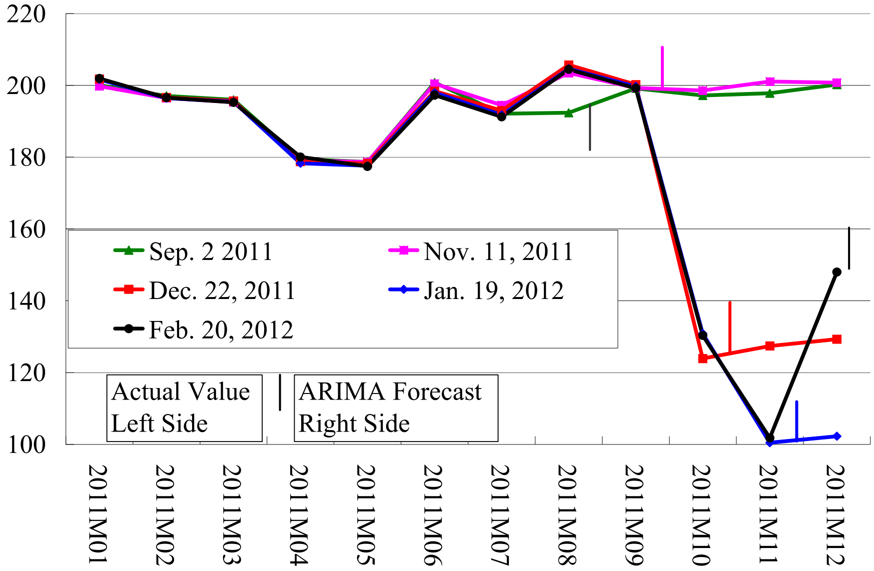
Nominal	SN1000	SN010	SN020	SN030	SN040	SN050	SN060	SN070	SN080	SN090	SN100	SN110	SN540
2011Q1	21.37	135.00	27.76	15.92	3.08	-4.89	-2.05	10.22	5.73	21.38	26.83	-6.62	5.92
2011Q2	-0.97	-19.33	15.27	-6.25	-6.41	-6.26	1.77	11.60	15.54	22.18	-2.59	13.66	14.40
2011Q3	8.13	-13.96	-16.40	21.11	21.98	-3.86	10.81	8.59	0.06	21.07	5.08	6.27	4.85
2011Q4	-17.28	-9.70	23.90	-39.02	-5.05	-5.02	5.71	-22.08	-29.49	10.96	2.62	9.22	8.01
2012Q1	6.53	31.83	8.80	-0.23	0.55	4.61	5.50	-8.62	12.64	7.13	2.83	6.22	5.88
2012Q2	5.92	-1.54	6.86	13.09	6.79	-0.36	0.51	5.10	-3.11	15.63	4.14	5.68	4.58

1000	GDP
010	Agriculture
020	Mining and Quarrying
030	Manufacturing
040	Electricity, Gas and Water Supply
050	Construction
060	Wholesale and Retail Trade
070	Hotels and Restaurants
080	Transportation, Storage and Communication
090	Financial Intermediation
100	Real Estate, Renting and Business Activities
110	Public Administration and Defense
540	Others (Education, Health and Social Work, Other Community, Social & Personal Service Activity, and Private Households with Employed Persons)

Source: CQM as of December 22, 2011.

Figure 2, the estimated production value index of Thailand, explains how CQM adjusts the estimated values using available sources. After getting additional available data, CQM updates its estimations to more reliable values. On September 2 and November 11, CQM did not have data of the damage caused by the flood and it could not assess the possibility of decreasing production. On December 22, CQM got partial information on the damage and revised the estimation values. Also, on January 19 and February 20, CQM revised its values accordingly from additionally obtained information.

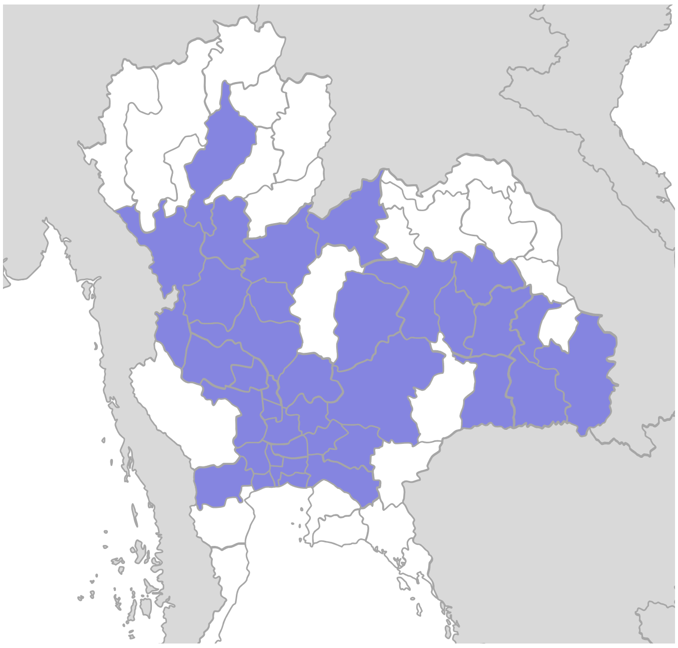
Figure 2: Production Value Index by CQM



Source: Kumasaka (forthcoming)

We assume that the damage shown in Table 9 in Q4 is proportionally distributed in the provinces affected by the flood, based on the total share of these provinces of the country in each industry. The affected provinces are shown in Figure 3. Finally, we get the value used in the assumptions of the simulations. We assume that each affected province has the same level of damage, as set out in Table 10.

Figure 3: Affected Provinces



Source: Compiled from JETRO's website as of November 11, 2011

Table 10: Assumptions of Damage in the Technological Parameters in 2011

Agriculture	-17.6%
Automotive	-19.8%
Electronics & Electrical Appliances	-15.0%
Textiles & Garments	-11.1%
Food Processing	-13.6%
Other manufacturing	-13.6%
Services	-2.8%

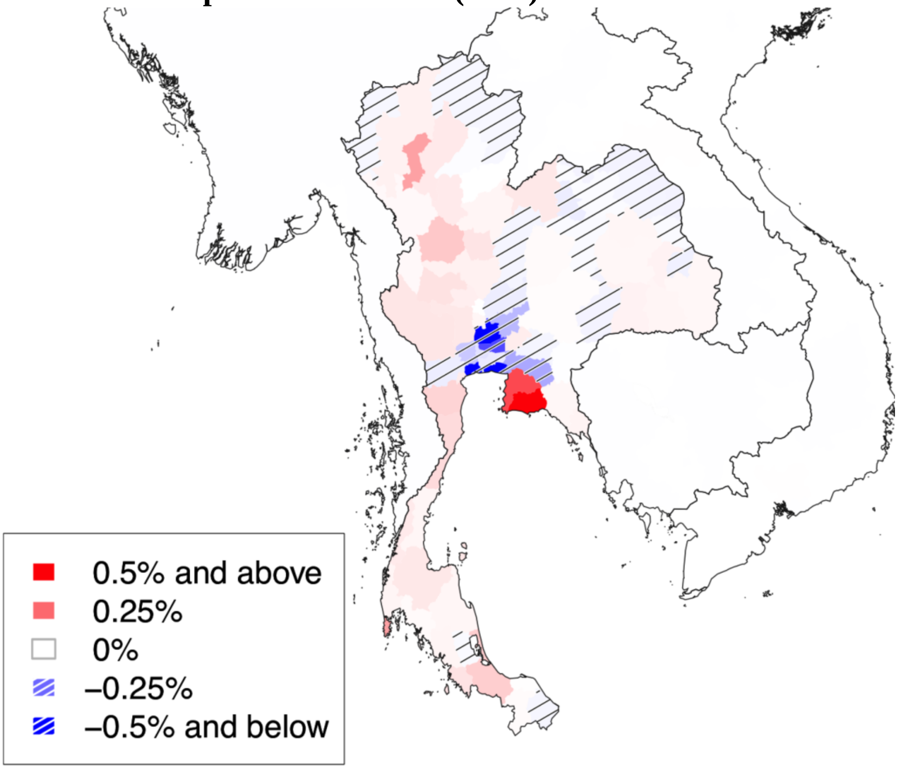
Source: Author derived based on CQM short-run forecasts.

In summary, Scenario 0 is described as follows:

Scenario 0:
The flood in Thailand
Technological parameters of affected provinces as shown in Figure 3 decrease by the percentage provided in Table 10 in 2011 and recover to the former value in 2012.

Figure 4 illustrates the economic impacts of the flood evaluated in the year 2020, compared with the baseline scenario. Red regions have positive impacts and blue or slashed regions have negative impacts. As explained in Figure 1, a negative impact does not necessarily mean a GDP below the present level. Samut Sakhon, Samut Prakarn and Ayutthaya provinces have larger negative impacts, because they have large scale electronics industries. Bangkok has a slight negative impact, reflecting the idea that service industries had less damage caused by the flood, and that services has a dominant share in the Bangkok economy.

Figure 4: Economic Impacts of the Flood (2020)



Source: IDE/ERIA-GSM 4.

Table 11 shows the top 7 negatively affected provinces and the top 4 positively affected provinces. Interestingly, there are many provinces positively affected, compared with the baseline scenario. This is because some households and firms move away from severely affected provinces to other areas, and thus some of these other areas will have more industrial activities than shown in the baseline scenario. Especially, Rayong and Chonburi are predicted to see 0.7% and 0.3% positive impacts, respectively. This can be interpreted as indicating that many companies move their production from Samut Sakhon, Samut Sakhon or Ayutthaya provinces to safer and better locations in other provinces. Lamphun, which has an electronics cluster, follows Rayong and Chonburi. Phuket also gets positive impacts from tourism shifting from Bangkok.

Table 11: Top 7 Negatively affected Provinces and Top 4 Positively affected Provinces

Region	Impact in GRDP
Samut Sakhon	-0.5%
Samut Prakarn	-0.5%
Ayutthaya	-0.5%
Pathum Thani	-0.3%
Chachoengsao	-0.1%
Saraburi	-0.1%
Nakhon Pathom	-0.1%

Region	Impact in GRDP
Phuket	0.1%
Lamphun	0.1%
Chonburi	0.3%
Rayong	0.7%

Source: IDE/ERIA-GSM 4.

As in Figure 4, other countries, such as Cambodia, Laos, Myanmar and Vietnam, have negligible impacts.[3] This means that replacement of the production lost in Thailand will be largely accomplished within Thailand, mainly led by Rayong and Chonburi provinces. In sum, Thailand as a country has almost 0% impact. China and Indonesia will have positive impacts though they are almost negligible. This can be supported by JETRO's interview survey of affected companies in January 2012; it reported that among 50 affected companies, 39 answered they would restart operations at their existing locations, while and the other 8 replied that they planned to relocate their production site to other areas of Thailand. The Japan Chamber of Commerce, Bangkok released another survey result showing that among 48 affected manufacturing companies, 41 answered that they would restart operations at their existing production sites and 12 reported they would restart in other areas in Thailand[4].

3.2. Recovery Scenario (1): MIEC and NSEC

At present Thailand, the Greater Mekong Sub-region and ASEAN have many

[3] We could not obtain flood damage data for Cambodia in terms of economic values, so we do not assume any damage for Cambodia.

[4] Multiple answers were allowed.

connectivity enhancement projects in hand. To assess the net effect of the negative impacts of the flood and the expected positive impacts from the connectivity enhancement, we run simulations including improving the Mekong-India Economic Corridor (MIEC, Scenario 1A) and the North-South Economic Corridor (NSEC, Scenario 1B). These scenarios are set as follows:

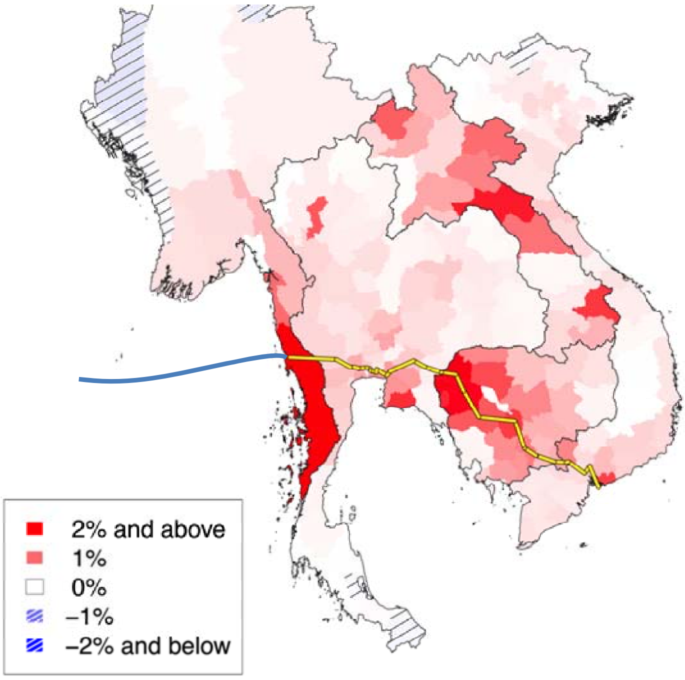
Scenario 1A: **Mekong-India Economic Corridor (MIEC)** A new bridge over the Mekong River at Neak Loueng in Cambodia is constructed. The speed of trucks along MIEC is raised in Cambodia and Vietnam to 60km/h. Dawei and Kanchanburi are connected by a road, and border crossing facilitation along the MIEC is introduced. Dawei and Chennai (India) are connected via a sea route that is equivalent to other international routes between equally important ports.

Scenario 1B: **North-South Economic Corridor (NSEC)** The speed of trucks along the NSEC is raised in Lao PDR, Myanmar and Vietnam to 60km/h. Border crossing facilitation along the NSEC is introduced.

Figures 5 and 6 present economic impacts of the MIEC and the NSEC, given the impact of the flood in the last subsection, respectively. In these scenarios, we do not assume increasing speeds of trucks within Thailand, because Thailand already has good national road networks. Even though we recognize some negative impacts of the flooding in these simulations and have no speed enhancement in Thailand, Figure 5 shows that Thailand will overcome the negative shock of the flood through the MIEC development. By comparing Figure 5 with Figure 6, we find that the NSEC has a relatively smaller positive impact on Thailand, because connecting Ho Chi Minh City, Phnom Penh and Bangkok and providing a new gateway toward India, the Middle East and Europe yield much larger benefits to Thailand.[5]

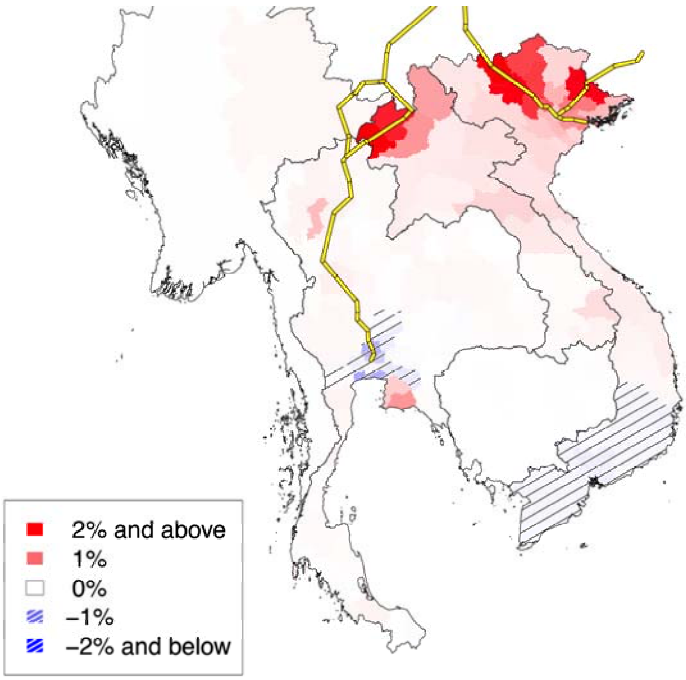
[5]The CADP report (ERIA, 2010) also compared the MIEC and the NSEC using IDE/ERIA-GSM version 3 and concluded that the MIEC has much larger economic impacts than the NSEC.

Figure 5: Economic Impacts of MIEC (2020)



Source: IDE/ERIA-GSM 4.

Figure 6: Economic Impacts of NSEC (2020)



Source: IDE/ERIA-GSM 4.

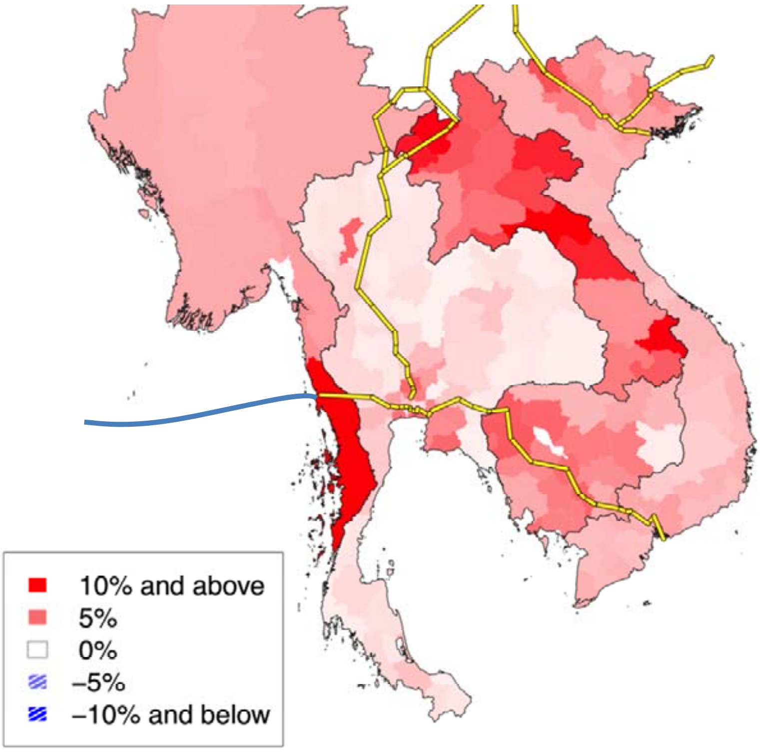
3.3. Recovery Scenario (2): MIEC, NSEC and Soft Infrastructure Development

We conduct another simulation of soft infrastructure development, together with the MIEC and the NSEC, given the impact of the flood. We assume Thailand, Cambodia, Lao PDR, Myanmar, Vietnam and India will reduce PCBs by 2% per year, presuming the situation that they are cooperatively improving institutional connectivity.

Scenario 2: **Soft infrastructure improvement in addition to the other development and enhancement** Countries involved in the MIEC and NSEC reduce Policy and Cultural Barriers (PCBs) by 2% per year, in addition to the other development and link enhancement mentioned above.

Figure 7 illustrates the economic impacts of the MIEC, the NSEC and soft infrastructure development. These measures will help Thailand overcome the negative impact of the flood. Ayutthaya will have a 4.9% net positive impact, even allowing for the implicit negative impact of the flood. Samut Prakarn and Samut Sakhon have 4.8% and 4.6% positive impacts, respectively. Rayong, Chonburi and Lamphun which have relatively larger positive impacts caused by the flood will also see further economic benefit.

Figure 7: Economic Impacts of MIEC, NSEC and Soft Infrastructure Development (2020)



Source: IDE/ERIA-GSM 4.

4. Policy Recommendations and Concluding Remarks

Simulation results show that the long-run impact of the flood in Thailand may not be as great as previously thought. Positive impacts in Rayong or Chonburi, for example, can only be simulated by a model with CGE setting, including many provinces. At an early stage of the disaster, many partial observations or interviews are collected in severely damaged areas, which may lead to overestimating the long-run damage. Utilizing IDE/ERIA-GSM with an assumption from the Current Quarter Model (CQM) provides a solution to cope with this bias. In fact a preliminary report of this study, with the message that the long-run impact of the flood might not be as great as previously thought, was conveyed to the National Economic and Social Development Board (NESDB) and the Committee of Permanent Representatives (CPR) member of Thailand in January and February 2012.

We conclude with our findings, policy recommendations and some limitations or challenges.

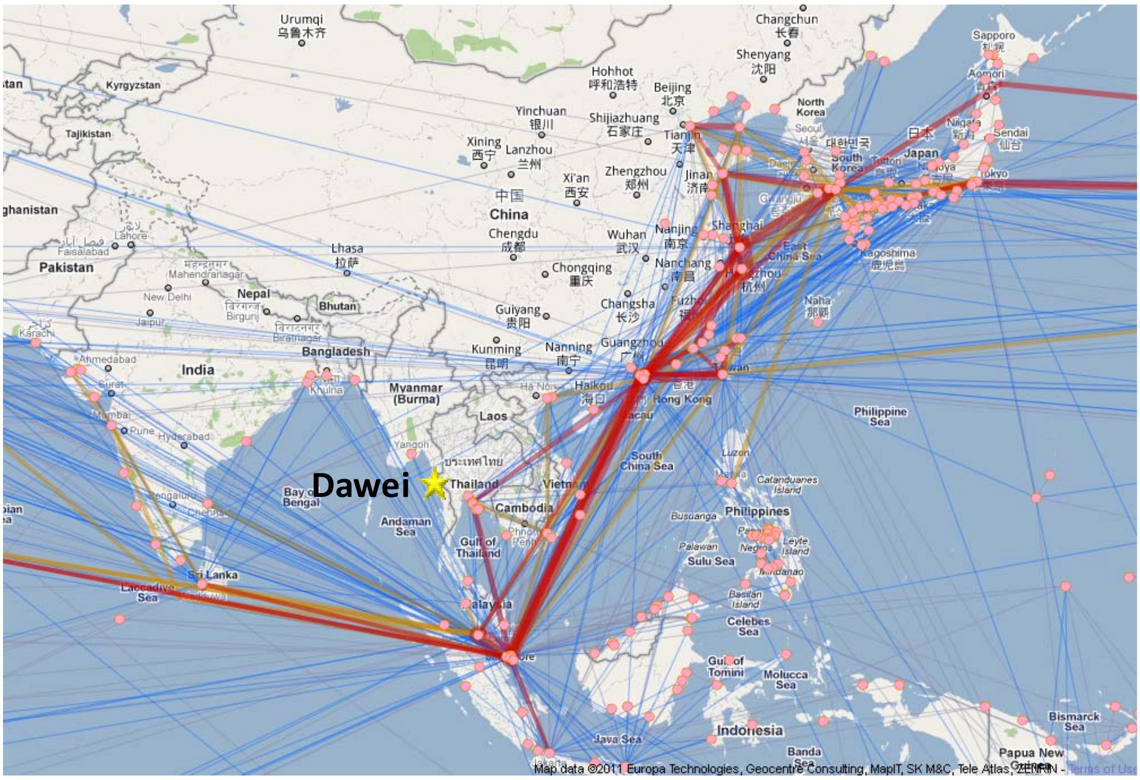
First, minimizing the damage arising from the flood and minimizing future risk are essential. We assume smooth recovery from the flood. If the Thai government had not offered good recovery measures, the flood's negative impacts would be larger. In fact many companies in JETRO's interview survey responded that they wanted to ask the Thai government to provide a good disaster insurance scheme and to develop tangible flood countermeasures.

Secondly, some facilitation measures to help firms move some production blocks from affected provinces to Rayong or Chonburi may contribute to Thailand's recovery. This does not mean, of course, that we recommend the forced relocation of firms. As reported in the media, many companies are already seeking production sites in industrial estates in Chonburi, Rayong and Lamphun, and developers are planning to establish new industrial estates. Our recommendation is that these movements should not be impeded, even though the government must be aiming for an equitable development of the country.

Thirdly, stimulating R&D activities and innovation is indispensable. In the simulations we assume full recovery of production infrastructure in 2012. However, if Thailand saw a delay in conducting R&D activities and other countries went ahead in 2011, possible negative impacts compared to the baseline scenario would be much larger.

Fourthly, even though we forecast a favorable result from the MIEC, several conditions are required to make it possible. There needs to be a smooth transaction flow between Dawei and the Kanchanburi border. Dawei port should be large and efficient enough to host international carriers, as in Laem Chabang or Tanjung Priok, because Dawei itself is located far from the major international sea lines (Figure 8).

Figure 8: International Maritime Shipping Routes (2009)



Note: Blue (narrow) lines: more than once/week. Yellow lines: more than once/day. Red (thick) lines: more than twice/day.
Source: Authors. Original Map is obtained from the Google Maps.

Fifthly, and finally, the assumptions used in this chapter need to be reviewed repeatedly in order to produce more reliable results. For example, we assumed that Samut Prakan was affected by the flood, based on information from JETRO as in November 2011. Actually Samut Prakan was affected by the flood, but no industrial estates in Samut Prakan were damaged. In this regard, the result for Samut Prakan in Figure 4 should be overestimated, even though some companies in Samut Prakan are in fact now seeking alternative sites considering their vulnerability to flooding. Similarly, the result as of January 2012 did not detect booming demand for construction in 2012. Nevertheless, IDE/ERIA-GSM can be a good tool for assessing the long-run effects of severe disasters and identifying possible remedies.

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