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Economic Impacts to Be Brought by the DPRK’s Return to International Society: CGE Analysis with the GTAP 9A Data Base

Enkhbayar Shagdar and Tomoyoshi Nakajima
Senior Research Fellows, Research Division
Economic Research Institute for Northeast Asia (ERINA)

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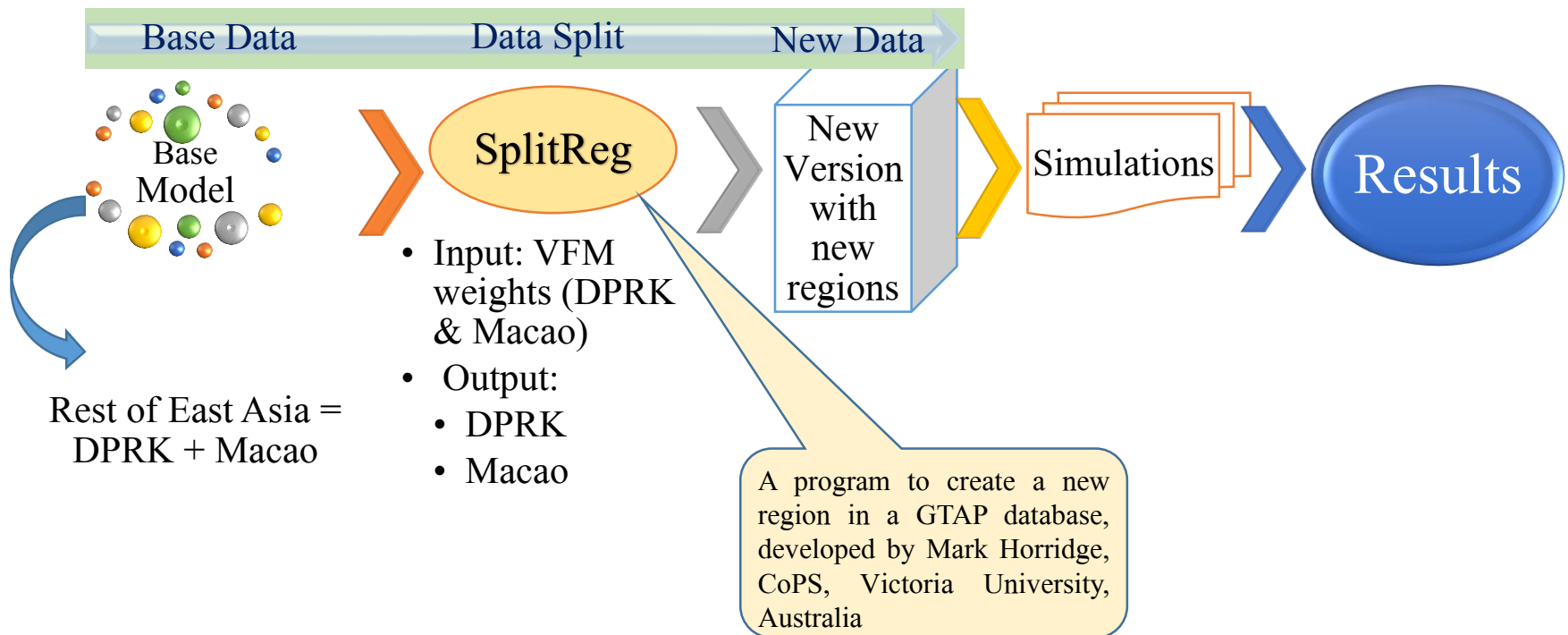
1. Introduction & Model Specifications
2. Data
3. Simulation Scenarios
4. Results
5. Conclusions

1 Introduction

Data: GTAP Data Base 9A (April 2016)

Model: Standard GTAP Model, Version 6.2

- Reference year: 2011
- Regions/countries: 140
- Sectors: 57 GTAP commodities



Aggregated Regions (GTAP 140 regions)

App. I

- 1 China
- 2 Japan
- 3 ROK
- 4 Mongolia
- 5 Russia
- 6 Rest of East Asia(XEA)
 - 6 DPRK
 - 7 Macao
- (7) 8 EAEU4
- (8) 9 ASEAN9
- (9) 10 ANZI (Australia, New Zealand, India)
- (10) 11 Rest of Asia
- (11) 12 USA
- (12) 13 EU_28
- (13) 14 Rest of world

SplitReg

Aggregated sectors (GTAP 57 sectors)

App. II

- 1 Agriculture
- 2 Extraction
- 3 Light Manufacturing
- 4 Heavy Manufacturing
- 5 Utility
- 6 Construction
- 7 Government Services
- 8 Other Services

Aggregated production factors (GTAP 8 factors)

App. III

- Land
- Labor
- Capital
- Natural resources

Table 2.1 GDP and Expenditure Composition

Regions	Value, 2011 \$ Million	Composition				
		Consumption		Investment	Export	Import
		Household	Government			
1 China	7,321,874.6	0.363	0.135	0.461	0.267	-0.226
2 Japan	5,905,633.7	0.597	0.202	0.204	0.16	-0.162
3 ROK	1,202,462.7	0.527	0.144	0.31	0.513	-0.494
4 Mongolia	8,760.8	0.473	0.126	0.477	0.71	-0.786
5 Russia	1,904,794.3	0.495	0.185	0.218	0.292	-0.19
6 Rest of East Asia	52,322.8	0.454	0.155	0.296	0.438	-0.343
7 EAEU4	272,377.7	0.55	0.127	0.265	0.435	-0.377
8 ASEAN9	2,144,075.0	0.578	0.108	0.282	0.568	-0.536
9 ANZI	3,430,954.5	0.587	0.148	0.302	0.205	-0.242
10 Rest of Asia	1,194,499.3	0.668	0.104	0.205	0.543	-0.519
11 USA	15,533,785.1	0.701	0.165	0.185	0.121	-0.172
12 EU_28	17,666,263.0	0.599	0.22	0.19	0.393	-0.403
13 Rest of World	14,839,340.3	0.584	0.168	0.217	0.306	-0.274
Total	71,477,143.7	0.589	0.176	0.235	0.282	-0.282

Source: GTAP 9A Data Base (2011).

Table 2.2 Rest of East Asia: Primary Factor Purchases, by Firms, at market prices (VFM), 2011 \$ Million

Sectors	Land	Labor	Capital	Natural Resources	Total
1 Agriculture	1,124.3	1,227.3	345.4	-	2,697.0
2 Extraction	-	278.1	1,199.6	763.7	2,241.4
3 Light Manufacturing	-	1,224.6	922.9	-	2,147.5
4 Heavy Manufacturing	-	1,237.2	899.0	-	2,136.3
5 Utility	-	364.3	482.7	-	847.0
6 Construction	-	1,943.6	660.8	-	2,604.4
7 Government Services	-	6,572.3	4,370.8	-	10,943.1
8 Other Services	-	9,572.7	11,979.3	-	21,552.0
9 Capital Goods	-	-	-	-	-
Total	1,124.3	22,420.0	20,860.6	763.7	45,168.7

Note: VFM= variable in GTAP Model representing firms' primary factor purchases at market prices.
Source: GTAP 9A Data Base (2011).

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➤ Data Split: Assigning the User Weights in SplitReg

2 Data

Table 2.3 DPRK and Macao Value Added by Economic Activity in 2011 (NAMAD)

Table 2.2

Economic Activity	DPRK		Macao		Total
	Share, %	Value, at current prices, \$ Million	Share, %	Value, at current prices, \$ Million	Value, at current prices, \$ Million
Agriculture, hunting, forestry, fishing (ISIC A-B)	23.1	3,616.9	0.0	0.0	
Mining, Manufacturing, Utilities (ISIC C-E)	39.7	6,225.0	1.57	369.2	
Manufacturing (ISIC D)	21.9	3,443.2	0.72	169.5	
Mining*			0.0	0.0	
Utility*			0.85	200.1	
Construction (ISIC F)	7.9	1,240.0	4.94	1,162.9	
Wholesale, retail trade, restaurants and hotels (ISIC G-H)		-	14.8	3,479.2	
Transport, storage and communication (ISIC I)		-	3.27	769.5	
Other Activities (ISIC J-P)	29.4	4,607.4	75.4	17,760.1	
Total	100.0	15,689.3	100.0	23,540.9	39,230.2

Notes: 1. ISIC=International Standard Industrial Classification;

Source: Compiled from NAMAD (National Accounts Main Aggregates Database), DESA, UN, 2019.

Table 2.4 (VFM) User Weights: Value-added by New Regions, 2011 \$ Million

Slide 8 T2.3

Sectors	1 DPRK	2 Macao	Rest of East Asia (VFM) (Output: Basedata.har)
1 Agriculture	2,703.5	0	2,703.5
2 Extraction	2,240.6	0	2,240.6
3 Light Manufacturing	1,968.1	(NAMAD) 169.5	2,137.6
4 Heavy Manufacturing	2,141.2	0	2,141.2
5 Utility	670.5	(NAMAD) 200.1	870.6
6 Construction	1,449.1	(NAMAD) 1,162.9	2,612.0
7 Government Services	(residual) 8,681.4	(residual) 2,307.0	10,988.4
8 Other Services	(NEA DB:8.2%)1,773.5	19,701.4	21,474.9
Total	21,627.9	23,540.9	45,168.8

➤ New Data: (Base Data of New Version)

2 Data

Table 2.5 Endowments - Firms' Purchases at Market Prices by Sectors (VFM), \$ million

Sectors	Before Split	After Split			Discrepancy
	Rest of East Asia (1)	DPRK	Macao	Total (2)	(1-2)
Agriculture	2,697.0	2,562.6	123.7	2,686.3	10.7
Mining	2,241.4	2,077.6	101.0	2,178.6	62.8
Light manufacturing	2,147.5	1,774.4	292.3	2,066.7	80.8
Heavy manufacturing	2,136.3	2,067.9	52.6	2,120.5	15.8
Utility	847.0	620.0	211.7	831.7	15.3
Construction	2,604.4	1,235.3	1,356.5	2,591.8	12.6
Government service	10,943.1	7,184.5	3,428.1	10,612.6	330.5
Other service	21,552.0	2,472.7	19,093.1	21,565.8	-13.8
Total	45,168.7	19,995.0	24,659.0	44,654.0	514.7

Note: The results reported here were obtained using the SplitReg program developed by Mark Horridge (2011).

Source: GTAP 9A (2011) Data Base.

Table 2.6 GDP of the New Regions: DPRK and Macao

	Consumption	Investment	Government	Export	Import	Total
	Value, 2011 \$ million					
DPRK	10,553.6	6,948.4	4,600.3	9,198.7	(7,792.2)	23,508.7
Macao	13,206.3	8,554.2	3,503.2	13,705.5	(10,734.6)	28,234.5
Total	23,759.9	15,502.6	8,103.4	22,904.1	(18,526.9)	51,743.3
Rest of East Asia*	23,579.9	15,502.6	8,103.4	22,903.9	(17,947.1)	52,322.8
	Share, %					
DPRK	44.9	29.6	19.6	39.1	-33.1	100
Macao	46.8	30.3	12.4	48.5	-38.0	100

Note: 1. The results reported here were obtained using the SplitReg program developed by Mark Horridge (2011).

2. *-Rest of East Asia values before split.

Source: GTAP 9A (2011) Data Base.

3 Simulation Scenarios

I Productivity Growth: The DPRK's Total Factor Productivity (TFP) grows by 30%:

- Takayasu, Yuichi, Daito Bunka University, Japan (Data by the Korean Statistical Information Service (KOSIS): <http://kosis.kr>):
 - The ROK's non-agricultural labor productivity growth: 51.8% in 1963-1973;
- William Easterly and Ross Levine (2001):
 - TFP accounts for 60% of growth of output per worker for an average country;
- TFP growth assumption: 30%.
 - ❖ *Shock avareg ("DPRK") = 30*
 - avareg ("REG") = Value-added technical change variable for the region "r"*

II Korean Unification:

- Removal of bilateral import tariffs between the DPRK and ROK:
 - ❖ *Shock tms(TRAD_COMM, "DPRK", "ROK") = target% 0 from file tms.shk;*
 - ❖ *Shock tms(TRAD_COMM, "ROK", "DPRK") = target% 0 from file tms.shk;*

"tms (i,r,s)" = Source-specific change in tax on imports of commodity "i" from region "r" into country "s"

3 Simulation Scenarios (cont'd)

III Northeast Asia Free Trade Agreement (NEA6FTA):

- Currently, only two bilateral FTA in effect:
 - ❖ China-ROK FTA
 - ❖ Mongolia-Japan EPA
- A region-wide FTA would emerge in NEA region covering all six countries: China, Japan, Mongolia, Russia, the ROK and DPRK:
 - ❖ *Shock tms(TRAD_COMM,NEA5,"DPRK") = target% 0 from file tms.shk;*
 - ❖ *Shock tms(TRAD_COMM,"DPRK",NEA5) = target% 0 from file tms.shk;*
 - ❖ *Shock tms(TRAD_COMM,NEA5,NEA5) = target% 0 from file tms.shk;*
- Subregion “NEA5” in the CMFSTART file:
 - XSET NEA5 #NEA5 regions#
 - (China, Japan, ROK, Mongolia, Russia);
 - XSUBSET NEA5 is subset of REG;
- *International capital mobility (RORDELTA=1);*
- *Solution method: Gragg (a multiple step extrapolation method);*

4 Results

Economic Impacts to Be Brought by the DPRK's Return to International Society

Table 4.1 Welfare Changes (Equivalent Variation, \$ Million)

Regions	TFP growth in the DPRK	Korean Unification	NEA6 FTA
1 China	213.1	-0.345	7,717.9
2 Japan	36.9	-0.182	19,396.6
3 ROK	24.6	-0.844	7,490.6
4 Mongolia	-1.8	0.004	19.5
5 Russia	-60.6	0.087	1,315.7
6 DPRK	6,586.4	1.730	107.2
7 Macao	0.1	0.001	-33.0
8 EAEU4	-6.9	0.013	-257.1
9 ASEAN9	8.9	-0.054	-4,439.1
10 ANZI	7.2	0.009	-2,113.8
11 Rest of Asia	42.4	-0.026	-3,226.5
12 USA	101.5	-0.232	-8,065.8
13 EU_28	275.1	-0.628	-7,670.1
14 Rest of the World	-186.0	0.343	-6,325.3

Note: The results reported here were obtained using the GEMPACK economic modelling software [[Horridge et al. \(2018\)](#)].

Table 4.2 (Scenario I) Welfare Effects of the DPRK's TFP Growth: EV Decomposition Summary (\$ Million)

Regions	Allocative Efficiency	Technical Change	Terms of Trade in Goods and Services	Terms of Trade in Investment and Savings	Total Welfare
1 China	74.3	0.0	204.7	-65.8	213.2
2 Japan	-3.3	0.0	46.2	-5.9	36.9
3 ROK	0.9	0.0	28.9	-5.2	24.6
4 Mongolia	-0.2	0.0	-1.6	-0.1	-1.8
5 Russia	-21.9	0.0	-31.0	-7.7	-60.6
6 DPRK	558.1	6,399.5	-502.2	130.9	6,586.3
7 Macao	0.0	0.0	0.4	-0.3	0.1
8 EAEU4	0.1	0.0	-5.8	-1.3	-6.9
9 ASEAN9	0.3	0.0	18.6	-10.1	8.9
10 ANZI	6.6	0.0	5.4	-4.9	7.2
11 Rest of Asia	-1.4	0.0	47.8	-4.0	42.4
12 USA	10.9	0.0	58.6	32.0	101.5
13 EU_28	26.8	0.0	258.0	-9.6	275.1
14 Rest of World	-0.1	0.0	-141.2	-44.7	-186.0
Total	651.2	6,399.5	-13.2	3.4	7,041.0

Note: The results reported here were obtained using the GEMPACK economic modelling software [Horridge et al. (2018)].

(Scenario 1) DPRK's Welfare Effects by Commodity

Figure 4.1 Technical Change Effect by Commodity

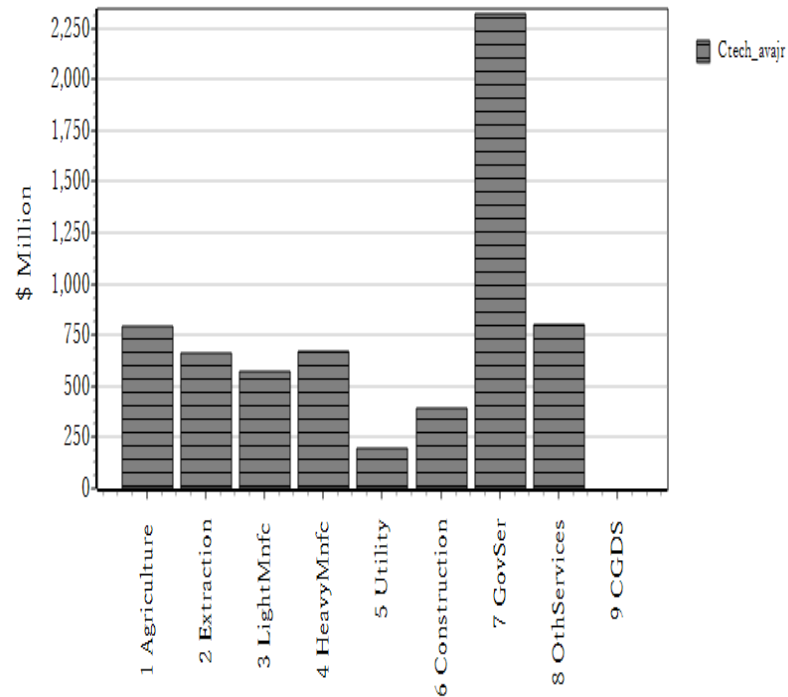
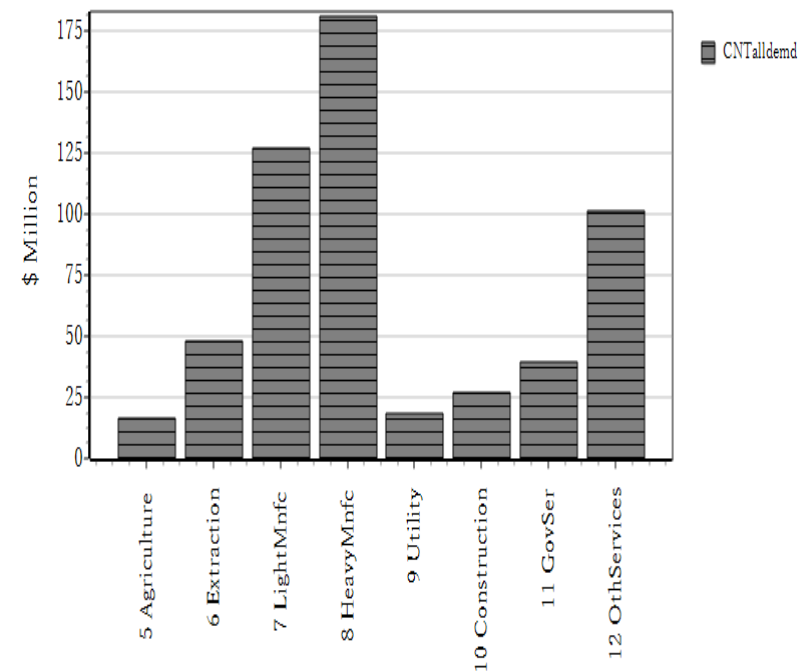


Figure 4.2 Allocative Efficiency Effect by Commodity



Note: The results reported here were obtained using the GEMPACK economic modelling software [Horridge et al. (2018)].

Table 4.3 Real GDP (qgdp) Changes, % change

Regions	TFP growth in the DPRK	Korean Unification	NEA6 FTA
1 China	0.001	0	0.072
2 Japan	0	0	0.033
3 ROK	0	0	0.078
4 Mongolia	-0.002	0	0.132
5 Russia	-0.001	0	0.043
6 DPRK	29.856	0.002	0.104
7 Macao	0	0	-0.006
8 EAEU4	0	0	-0.029
9 ASEAN9	0	0	-0.038
10 ANZI	0	0	-0.01
11 Rest of Asia	0	0	-0.017
12 USA	0	0	-0.003
13 EU_28	0	0	-0.006
14 Rest of the World	0	0	-0.012

Note: The results reported here were obtained using the GEMPACK economic modelling software [[Horridge et al. \(2018\)](#)].

Results

Table 4.4 Effects on Investment by Regions qo[CGDS*])

Regions	% change			Level change, \$ Million		
	TFP growth in the DPRK	Korean Unification	NEA6 FTA	TFP growth in the DPRK	Korean Unification	NEA6 FTA
1 China	0.007	0	0.347	234.5	-0.5	11,712.8
2 Japan	0.003	0	1.591	30.8	-0.1	19,158.8
3 ROK	0.005	0	5.718	19.8	0.9	21,296.3
4 Mongolia	-0.03	0	5.241	-1.3	0.0	219.0
5 Russia	0.002	0	1.283	6.7	0.0	5,336.3
6 DPRK	21.897	0.011	0.399	1,521.5	0.8	27.7
7 Macao	0	0	-0.301	0.0	0.0	-25.7
8 EAEU4	0.002	0	-0.559	1.3	0.0	-403.3
9 ASEAN9	0.004	0	-0.597	25.0	-0.1	-3,613.1
10 ANZI	0.003	0	-0.256	27.3	0.0	-2,649.3
11 Rest of Asia	0.011	0	-0.965	27.1	0.0	-2,360.6
12 USA	0.004	0	-0.574	121.0	-0.3	-16,499.3
13 EU_28	0.007	0	-0.426	229.8	0.0	-14,300.8
14 Rest of World	0.001	0	-0.321	21.3	0.0	-10,346.3
Global				2,264.6	0.7	7,552.7

Note: The results reported here were obtained using the GEMPACK economic modelling software [[Horridge et al. \(2018\)](#)].

Table 4.5 DPRK: Output Changes by Industry
(qo[*DPRK], % change)

Sectors	TFP growth in the DPRK	Korean Unification	NEA6 FTA
1 Agriculture	27.489	-0.003	0.579
2 Extraction	32.213	-0.015	-0.980
3 Light Manufacturing	29.061	0.115	8.412
4 Heavy Manufacturing	30.791	0.004	-1.145
5 Utility	28.465	-0.039	-3.006
6 Construction	22.994	0.007	0.186
7 Government Services	30.075	-0.023	-1.454
8 Other Services	34.501	0.002	-0.018
9 Capital Goods	21.897	0.011	0.399

Notes: 1. qo(NSAV_COMM,REG) [%-change]: industry output of commodity i in region r: "DPRK" column;

2. The results reported here were obtained using the GEMPACK economic modelling software [[Horridge et al. \(2018\)](#)].

5 Conclusions

- ❑ The DPRK may benefit from each scenario, with the largest welfare gain being in the productivity growth scenario;
- ❑ The DPRK's productivity growth and GDP expansion would stimulate additional investments worldwide;
- ❑ There will be winners and losers in the DPRK's industry in the Korean Unification scenario:
 - ❖ Light and heavy manufacturing, construction and other services sectors would benefit;
 - ❖ while the remaining sectors would see their outputs decline;
- ❑ All the economies in Northeast Asia will benefit in the NEA FTA scenario:
 - ❖ Most of these gains were associated with terms of trade gains in goods and services and allocative efficiency improvements;
 - ❖ The region would attract large investment pools as well.

Key References

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Thank you for your kind attention!

ERINA Economic Research Institute for Northeast Asia
13F, Bandaijima Bldg, Bandaijima 5-1, Chuo-ku,
Niigata-city, 950-0078 Japan
Tel: 025-290-5545
Fax: 025-249-7550
Web: <http://www.erina.or.jp>

Appendix I: Classification of Regions in the Model

The Model (13 regions)	GTAP 9.0a (140 regions)
China	China
Japan	Japan
ROK	Republic of Korea
Mongolia	Mongolia
Russia	Russian Federation
Rest of East Asia	Rest of East Asia: - Korea, Democratic People's Republic of - Macao, Special Administrative Region of China
EAEU4	Kazakhstan, Kyrgyzstan, Armenia, Belarus
ASEAN9	ASEAN9 members, except Myanmar: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Vietnam
ANZI	Australia, New Zealand, India
Rest of Asia	Hong Kong, Taiwan, Rest of Southeast Asia, Bangladesh, Nepal, Pakistan, Sri Lanka, Rest of South Asia
USA	United States of America
EU_28	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom , Bulgaria, Romania, Croatia
Rest of World	Rest of Oceania, Canada, Mexico, Rest of North America, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Rest of South America, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Rest of Central America, Dominican Republic, Jamaica, Puerto Rico, Trinidad and Tobago, Caribbean, Switzerland, Norway, Rest of EFTA, Albania, Ukraine, Rest of Eastern Europe, Rest of Europe, Rest of Former Soviet Union, Azerbaijan, Georgia, Bahrain, Islamic Republic of Iran, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, Rest of Western Asia, Egypt, Morocco, Tunisia, Rest of North Africa, Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, Rest of Western Africa, Central Africa, South Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa, Botswana, Namibia, South Africa, Rest of South African Customs, Rest of the World

Source: GTAP 9.0a Data Base and Model Aggregation output

Appendix II: Classification of Sectors in the Model

No.	The Model (8 sectors)	GTAP 9.0a (57 sectors)
1	Agriculture	Paddy rice; Wheat; Cereal grains nec.; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops nec.; Cattle, sheep, goats, horses; Animal products nec.; Raw milk; Wool, silk-worm cocoons; Meat: cattle, sheep, goats, horse; Meat products nec.; Processed rice;
2	Extraction	Forestry; Fishing; Coal; Oil; Gas; Minerals nec.
3	Light Manufacturing	Vegetable oils and fats; Dairy products; Sugar; Food products nec.; Beverages and tobacco products; Textiles; Wearing apparel; Leather products; Wood products; Paper products, publishing; Metal products; Motor vehicles and parts; Transport equipment nec.; Manufactures nec.
4	Heavy Manufacturing	Petroleum, coal products; Chemical, rubber, plastic products; Mineral products nec.; Ferrous metals; Metals nec.; Electronic equipment; Machinery and equipment nec.;
5	Utility	Electricity; Gas manufacture, distribution; Water;
6	Construction	Construction;
7	Government Service	Public administration, defense, health, education; Communication ; Financial services nec. ; Insurance ;
8	Other Services	Trade; Transport nec.; Sea transport; Air transport; Business services nec.; Recreation and other services; Dwellings;

Notes: 1.The original sectors in the GTAP Data Base 9A start with capital letters; 2.nec.= not elsewhere cited.

Source: GTAP 9.0a Data Base and Model Aggregation output

Appendix Table III: Classification of Production Factors in the Model

No.	The Model (4 factors)	GTAP 9.0a (8 factors)	Description
1	Land	Land	Immobile
2	Labor	Technicians/Associates, Professional; Clerks; Service/Shop workers; Officials and Managers; Agricultural and Unskilled	Mobile
3	Capital	Capital	Mobile
4	Natural Resources	Natural Resources	Immobile

Note: The original factors in the GTAP Data Base 9A start with capital letters.

Source: GTAP 9.0a Data Base and Model Aggregation output

Slide 5 GDP