SIMULATION RESULTS ON INTERNATIONAL MARITIME CONTAINER VOLUME AMONG ASIAN COUNRTIES BY GTAP MODEL UNDER FTA AND TRANSPORT IMPROVEMENT SCENARIO *

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1. Introduction

Globalization and regionalism are the major trends in today's global economy. As the world economy becomes more integrated, the development of international trade is greatly stimulated, and maritime transport, which is a primary mode in terms of international freight transport especially in Asia region, experiences a remarkable development. Many Asian ports are becoming the busiest ports in the world in terms of the container cargo handled volume. There is an increasing demand for quantitative analyses of the impact of economy integration policy issues on the international marine transport.

Numerous studies have been conducted on the impact of economic integration policies on many industries with general equilibrium analysis (Nakajima 2002, etc.). However, few researches focus on the impact of these policies on international maritime transport industry. Therefore, a model was developed by integrating a transport network assignment model with an international trade model by us. The conceptual framework of this model is shown in Figure 1 as follows.

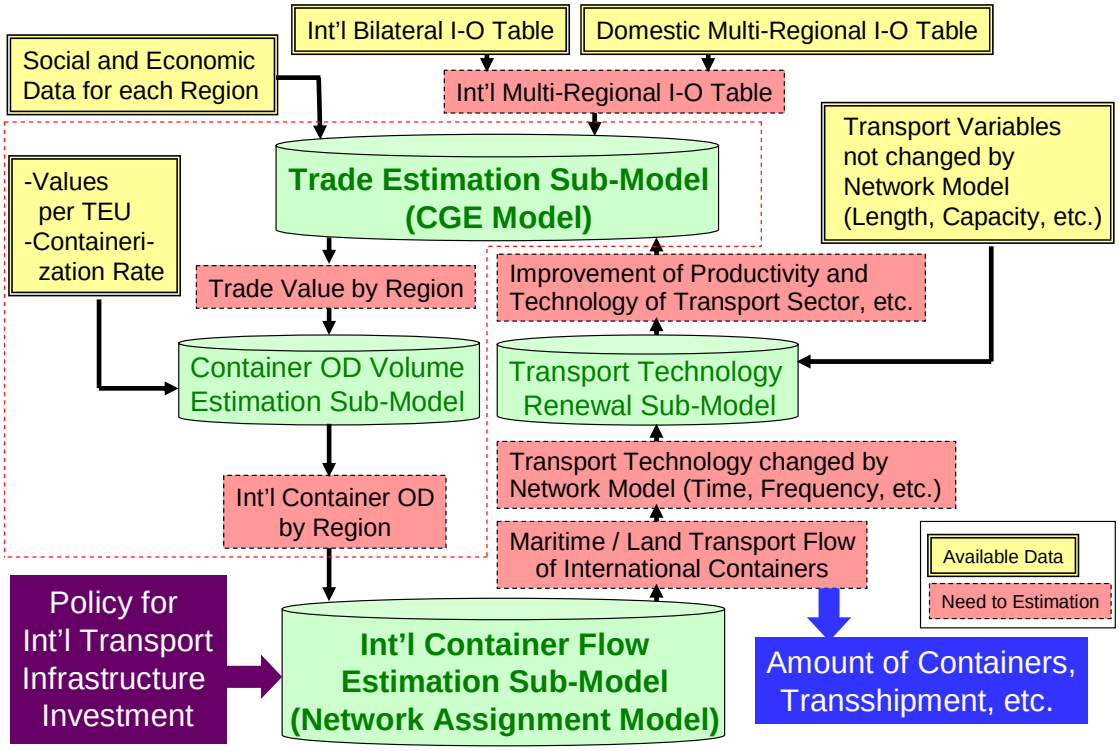

Figure 1: Integrated trade-freight forecasting system

As a part of the above researches, this paper focuses on container OD volume estimation sub-model as shown in the red dash-dot line area in Figure 1. This study aims to propose a method to estimate the container OD flow changes under the various regional economic integrations, such as FTA and transport technology improvement by integrating the simulation results of the Global Trade Analysis Project (GTAP) model, which is a multi-regional CGE (Computable General Equilibrium) model. In this paper, first, the proposed method and data preparation are described, and then the two applications of this method are introduced. One is FTA scenario analysis by assuming various hypothetical FTA memberships and tariff settings; the other is the transport technical progress scenarios analysis. The effects of FTA scenarios and transport technical progress scenarios on each country's economy, trade and container OD flows were compared and examined.

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2. Method Description and Dataset Preparations

(1) Method description

In this study, by changing various policy shocks in the GTAP model, new outputs can be obtained of the matrix of commodity-based bilateral trade monetary-based amount flows among the targeted countries and corresponding other factors such as GDP changes. In order to obtain the international container shipping OD flows under the regional economic integration, it will need method to transform the outputs of GTAP model, which are only of the matrix of commodity-based bilateral trade volume in monetary-base, to the TEU-based container flows. The each step of this method is descried below.

a) First, Modal Split: International trade commodities are carried by different transport modes. There is an international transport sector in the GTAP model, which provides the services that account for the difference between FOB and CIF values. This international transport sector consists of air transport, marine transport and land transport. Therefore, the modal share of marine transport must be determined. Due to the low validity of the modal share in the GTAP, which is the United States based dataset, in this study, modal share was derived from the share of trade amounts carried by each transport modal originating from or destined for Japan, using data obtained from the 1997 and 2001 trade statistics of the Ministry of Finance, Japan.

b) Second, Transform Monetary Units to Freight-Ton: By using each commodity's unit price (USD/FT) and its trade amount by marine transport, the FT-based weight can be obtained. The commodity unit price is derived from the 1996 Port Statistics Yearbook of Japan.

c) Third, Containerized Commodity Ratio: Not all commodities for marine transport can be carried by containers; therefore, the containerized ratios of the different commodities must be examined. Because we were unable to obtain all containerized ratios for each commodity on each route, Japanese commodity-based containerized ratios were used, which were obtained from the data of the 1997 Survey Report of International Container Cargo Flow.

d) Fourth, TEU Transformation: It is difficult to identify the number of tons of one TEU cargo for each commodity. In this study, the value of 19.0 Freight-Ton/TEU was used, which was taken from the Description Handbook of Port Investment Evaluation, published by the Port Investment Evaluation Committee of Japan.

Since the reference materials have a commodity categories code system that differs from the GTAP codes, they had to be categorized again according to the GTAP code. For the modal share, the HS code (Harmonized Commodity Description and Coding System) was used, which has 97 categories. For the containerized ratio, the port statistic code system was used, with 54 categories. These trade amounts of commodities were aggregated again according to the GTAP model, and then the GTAP was used to calculate the commodity-based matrix of trade flow among the selected countries. Using the reorganized modal share and containerized ratio of each commodity to obtain its container OD flow, the aggregate of all commodities' container OD flows was calculated.

(2) Classification of regions

GTAP version 5.4 and version 6.0 database were used, which is the 1997 and 2001datasets for 66 countries and regions. In this study, thirty countries and regions were selected in order to apply the calculation data for our international transport network model (Shibasaki, et al, 2004). First, the GTAP model was used to calculate the GDPs and trade amounts of all these countries, and then the outputs were aggregated according to the main seven regions divisions shown in Table 1.

Table 1: Classification of region

No.	Code	Description	Region	No.	Code	Description	Region
1	idn	Indonesia	ASEAN	16	nzl	New Zealand	ROW
2	mys	Malaysia		17	hkg	Hong Kong	
3	phl	Philippines		18	twn	Taiwan	
4	sgp	Singapore		19	inbg	India, Bangladesh	
5	tha	Thailand		20	lka	Sri Lanka	
6	vnm	Vietnam		21	xsa	Rest of South Asia	
7	chn	China	China	22	xcm	Central America, Caribbean	
8	jpn	Japan	Japan	23	per	Peru	
9	kor	Korea	Korea	24	chl	Chile	
10	M	Mediterranean Countries	EU	25	xap	Rest of East Southern America	
11	E	EU		26	wsa	West Southern America	
12	can	Canada	NAFTA	27	rus	Russia	
13	usa	USA		28	xme	Rest of Middle East	
14	mex	Mexico		29	ba	Black Africa	
15	aus	Australia	ROW	30	xrw	Rest of the World	

(Note: Among the ASEAN countries, GTAP model only has the databases on Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam.)

(3) Scenarios Settings

As the applications, the effects of FTA and transport technical progress scenarios on the selected countries' economies, bilateral trade amounts and container shipping transport flows were examined and discussed. Six combinations of FTA memberships were considered as shown in Table 2. The FTA Scenarios were examined under the various tariffs shown in Table 3. The tariff reduction setting is from 20% Off to 100% Off. It can be set in the GTAP by changing the shock variable tms (change in tax on imports of i from region r into s).

The transport technical progress scenarios were set to the same country combinations according to the corresponding FTA countries' combinations in Table 2. The transport technical progress of a country means the improvement ratio of its transport technology between the country and all its trade partner countries. For example, corresponding to FTA1, for PRO1 it was considered that the transport technology between Japan and all its trade partner countries was improved; meanwhile, the same change occurred between Korea and all its trade partner countries. Furthermore, the progress ratios were set from 50% down to 50% up as shown in Table 4. In the GTAP model, the shock variables were expressed as atf (tech change shipping from region r) and ats (tech change shipping to region s).

Table 2: FTA and transport technical progress scenario settings

FTA1	FTA2	FTA3	FTA4	FTA5	FTA6
JPN-KOR	JPN-CHN	CHN-KOR	JPN-CHN-KOR	JPN-ASEAN	JPN-CHN-KOR-ASEAN
PRO1	PRO2	PRO3	PRO4	PRO5	PRO6
JPN, KOR	-	-	JPN,CHN,KOR	JPN, ASEAN	JPN,CHN,KOR,ASEAN

Table 3: Tariff reduction sets

TAX20%OFF	TAX40%OFF	TAX50%OFF	TAX60%OFF	TAX80%OFF	TAX100%OFF

Table 4: Transport technical progress sets

TECH -50%	TECH -25%	TECH＋25%	TECH ＋50%

3. Application Results and Discussions

As space is limited, here, just discuss the application results on the container OD flow changes. Others will be presented on the conference. As an example, the aggregated results of Japan-China-Korea-ASEAN FTA with 50% tariff reduction and 50% transport technical progress in the corresponding countries in 2001 database were discussed. By using the proposed method, obtained the container OD flows changes as shown in Table 5, furthermore, Japan's import and export container OD flows in 2001 were shown in Figure 2.

Table 5: OD matrix of container cargo change in 2001 (unit: TEU)

- FTA6 with TAX50% OFF

From/To	JPN	CHN	KOR	ASE	NAFTA	EU	ROW	TOTAL
JPN	0	220,020	52,566	65,716	-71,909	-45,736	-43,122	177,534
CHN	273,642	0	446,713	61,615	-2,708	-8,998	-7,739	762,530
KOR	24,125	149,563	0	31,125	-24,027	-20,268	-25,626	134,892
ASE	45,857	122,364	25,645	67,650	-40,400	-51,735	-53,470	115,911
NAFTA	-33,464	-42,456	-174,474	-11,210	22,877	9,278	8,002	-221,448
EU	-33,930	-69,294	-20,815	-34,836	22,648	9,506	12,410	-114,311
ROW	-8,454	-59,601	-152,518	-24,277	32,247	29,915	30,482	-152,205
TOTAL	267,777	320,597	177,116	155,782	-61,272	-78,033	-79,063	702,904

- PRO6 with TECH+50%

From/To	JPN	CHN	KOR	ASE	NAFTA	EU	ROW	TOTAL
JPN	0	102,965	54,961	77,887	12,280	15,054	45,279	308,426
CHN	308,751	0	61,496	69,022	130,497	43,784	66,987	680,536
KOR	55,202	92,308	0	31,724	13,530	3,854	24,620	221,238
ASE	177,578	123,841	57,289	162,092	-12,131	-2,673	4,226	510,222
NAFTA	-563	89,949	46,772	65,174	-43,607	-51,998	-31,033	74,693
EU	84,077	161,251	30,731	44,093	14,787	2,028	-7,968	329,000
ROW	-18,954	567,216	10,684	139,909	-20,134	-66,873	-19,922	591,926
TOTAL	606,091	1,137,529	261,934	589,901	95,222	-56,825	82,189	2,716,041

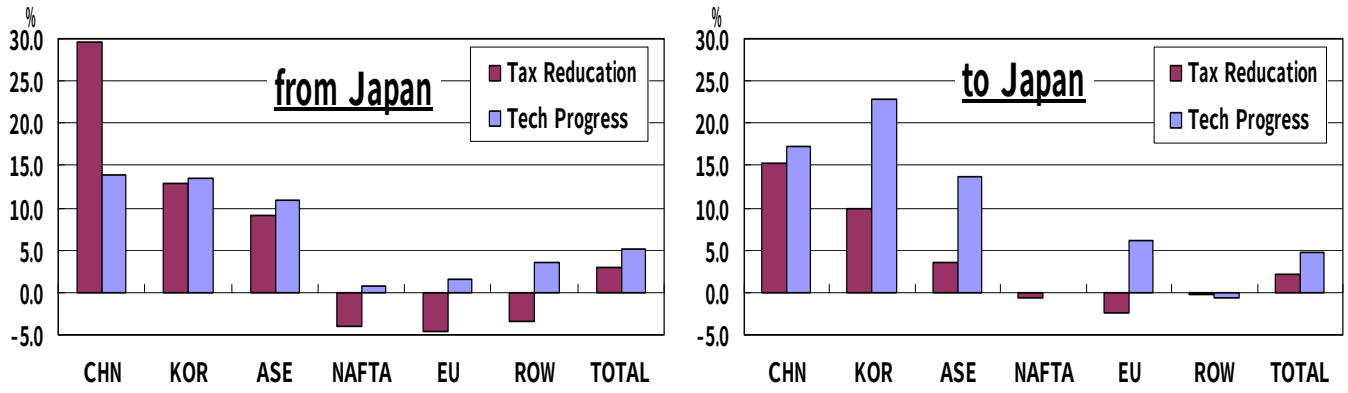

Figure2: Container volume change rates from/to Japan at FTA6 with TAX 50% OFF and PRO6 with TECH +50% in 1997

From Figure2, it can be seen that for Japan, the exported and imported container cargo volumes will increase only between the FTA and member countries and decrease between other countries and regions. But transport technical progress has the positive impact on the container volume increasing with all trade partners in all the cases. Furthermore, in case of the imported container cargo volume for Japan, 50% transport technical progress has the bigger impact than the 50% tariff reduction. Even examine the exported container cargo volume change for Japan, 50 %transport technical progress has almost same effect with 50% tariff reduction.

4. Conclusion

This study proposed a method for estimating the international container shipping transport OD flow under various changes in socioeconomic factors changes by using the GTAP model. In particular, as two applications in this study, the impacts of various regional economy integrations (FTA scenarios with different tariff reduction schemes) and transport technical progress on selected countries' economies especially in terms of international container shipping transport OD flows were examined and discussed.

This method has the following features.

1) This method can provide the commodity-based OD flow information among the studied countries from the relationship between international trade and container flows, by processing the outputs from the GTAP model. This research is also one of few applications of the GTAP model at the field of international maritime container transport network.
2) This method can also estimate the container OD flow changes under various FTA scenarios and transport technology improvement scenarios among several combinations of Asian countries incorporated in the outputs from the GTAP model, which will be a useful tool to do the economic policy evaluations on the international maritime container transport network.
3) The result of the research will be also an important step for the demand forecasting such as the volume of container handling and transshipment on the international container shipping transport network.

From the applications in this study, it was demonstrated that both FTA and transport technical progress almost all have the positive effects on container cargo volumes increasing, especially for the FTA member countries. These effects are increased by the growth in the number of the joined FTA membership countries. Due to the difference in each country's industry development level and structure, the GDP of some countries will decrease when it join the non-tariff FTA in some cases. This is because the import volume is higher than export volume. However, in term of the trade amount, it will increase. Consequently, containerized goods will always increase. The change in the trade pattern generates new container shipping transport OD flows. Additionally, since the calculation of the GTAP model is based on each commodity, the proposed method can show not only the change in total container cargo volume on each OD pair, but also indicate the change in commodity–based container goods composition on each route under these scenarios.

As future studies, the above results should be further examined and explained theoretically based on the model structure, and the accuracy of the method should be improved. Furthermore, since this OD estimation is on a national level, consideration should be given to a method for assigning the OD flow into each port at the selected countries in case one country has more than one port. This will be the next step in our study on the international shipping transport network.

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