EMPIRICAL ANALYSIS OF INTERNATIONAL ECONOMIC DEPENDENCIES BASED ON A THREE - NATION(CHINA-THAILAND-MYANMAR) INTERNATIONAL INPUT-OUTPUT TABLE

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The countries (Cambodia, the People's Republic of China, Lao PDR, Myanmar, Thailand, and Vietnam) in the Greater Mekong Sub-region (GMS) have been expected to develop international economic relations, notably in terms of cross-border trade and foreign direct investment. This paper attempts to measure and analyze the economic interdependencies, based on a three-nation international input-output (TNIIO) table constructed to link China, Thailand and Myanmar.

The result of analysis is that the economic interdependencies linking China, Thailand and Myanmar in the year 2005 were very weak in terms of the big difference of economic development stage or industrial structure in spite of the remarkable traffic development. It is very important to try to improve the transportation system and the legal framework of protective trade, and foreign direct investment. But if the free trade will be blindly promoted among three countries, the rich natural or human resources of low underdeveloped countries is apprehensive of the one-sided plunder. So it is necessary to seek to satisfy the mutual prosperity.

Keywords*: TNIIO, economic interdependencies, linkage, different economic development stage,leakage*

1. INTRODUCTIO

Economic integration in Association of South-East Asian Nations (ASEAN) has not only induced each country's growth but also accelerated diversities of industrial cluster or international assembly work among

Membership Countries. In this circumstances, the countries (Cambodia, the People's Republic of China, Lao PDR, Myanmar, Thailand, and Vietnam) in the Greater Mekong Sub-region (GMS)[*1,*2] have expected to develop international economic relations, notably in terms of cross-border trade and foreign direct investment. In fact GMS's economy has consistently experienced high economic growth in the last 10 years.[1)2)] International trade has likely influenced a significant impact on the GMS. This has prompted recent interest in measuring the total economic impacts on production on the region's national economies. We can observe that the GMS is economically a very attractive area as it could be a new frontier of Asian economic growth by completing the road of the North-South, East-West, and Southern economic corridors, being built to develop cross border transportation infrastructure. In addition, we can approximately find a total of 320 million people and 491.0 million US$ in gross domestic product (GDP) in GMS. This total means the value of Cambodia, Yunnan Province and Guanguxi Zhuang Autonomous Region in China, Lao PDR, Myanmar, Thailand, and Vietnam. So, we can really say GMS is a new frontier of Asian economic growth.

Under these circumstances, China, Thailand and Myanmar can be expected to play the important role in the GMS. China has the largest economic scale of GDP while Thailand has the second largest in the GMS. Also, Myanmar may be the country where remarkable economic development can be potentially expected in near future because of opening diplomatic relations and administrative reforms policies. Therefore, an effective review and analysis of the industrial structure linking China's, Thailand's and Myanmar's economies is needed to investigate deeply the economic circumstances of GMS.

While several econometric models have been developed to measure and analyze the macro-economic structure of the economy, their usefulness appears to be hampered by the lack of information at the micro level. Hence, the compilation of an appropriate database such as the input-output (IO) table must be needed. Indeed, the IO table can show not only the mutual relations of industrial structure in detail but also the economic influence on the internal and external countries through the analysis of economic impact on production. Furthermore, constructing an international IO table will not only allow us to estimate the stimulus to production outside the countries, but also the resultant impact on its output arising from the production stimulus it causes in the other countries. Accordingly, this paper attempts to measure and analyze the economic interdependencies among China, Thailand and Myanmar, made possible by constructing a three-nation international input-output (TNIIO) table.

The paper is structured as follows: Section 2 is concerned with previous studies related to this study. Section 3 outlines the accounting framework used to develop the TNIIO table. The methods and data used to construct the TNIIO table linking China, Thailand and Myanmar with year 2005 as the reference period are described in Section 4 before we discuss the salient findings of the interdependency among three countries in Section 5. Finally, Section 6 concludes.

2. PREVIOUS STUDIES RELATED TO THE INPUT OUTPUT TABLE FOR THE COUNTRIES OF GMS AND ITS ANALYSIS

The IO table was developed by W. Leontief.[10] It is said that the IO table was an attempt of adjusting General Equilibrium Theory of L. Walras to real national economy, and an attempt of making Tableau Economique of F. Quesnay for the United States' economy. After the utility and importance of the IO analysis came to be admitted widely, many countries including the U.S. have come to compile the IO tables as a tool for an in-depth analysis of the national economy of each country in the world. Under the development of compiling IO table, the United Nations (UN) guided the outline of constructing IO table based on the System of National Accounts (SNA) adopted by United Nations Statistical Commission in 1968.[19] Then the Organization for Economic Cooperation and Development (OECD) has constructed the world input-output database for forty countries worldwide to analyze the consequences of fragmentation which production processes increasingly across borders. Also focusing IO tables in Asian countries, Tamamura, Kuwamori, and Sano introduced and explained the background and history of the compilation of national IO table and international IO table in Asian countries, which were the national tables or international tables in preceding ASEAN countries, South Korea, Taiwan, and China.[16][17] Further the Asian Development Bank (ADB) constructed IO tables of selected economies in Asia and the Pacific, which were 18 economies. The ADB developed the IO tables for the economies by building on the results of the supply and use tables (SUT).

In the circumstances, we survey the compilation of national IO tables and international IO tables related to this study. **Thailand** has produced benchmark national IO table since 1975, and it has been compiled regularly every five years.[12] Its first IO table was compiled by the National Economic and Social Development Board (NESDB) in coordination with the National Statistical Office (NSO). Thailand has also been one of 10 partner countries involved in the periodic compilation of Asia international IO table as a continuing project of the Institute of Developing Economies-Japan External Trade Organization (IDE-JETRO), Japan since it started in the 70's. In collaboration with Asia Development Bank (ADB), Thailand has compiled a supply and use table (SUT) for 2007. In **Myanmar**, there is no benchmark national IO table compiled by the Government. Several compiling attempts were made by scholars or officers in Myanmar. However these IO table were not published except the latest table. In the latest a new estimated IO table in 2000-01 which was based on non surveys (secondary data) was compiled by Thwin Nan Khine Su, Yoshida, and Maeda in 2010.[18] This IO table was drawn based on the thirteen sectors. **China** has made benchmark national IO table since 1981, and it has 6 tables (1981-87-92-97-2002-07). China also joined the IDE-JETRO group in compiling the Asian International IO table, the latest one is for year 2005.

On the other hand we survey the analysis based on these IO tables related to this study. We can see a lot of papers regarding Thailand and China though there are few papers in Myanmar. However there are not many papers

regarding the interdependencies based on international IO within (1) Asia and the Pacific including GMS' countries or (2) GMS' countries. These mainly are as follows. As regards (1), these are the degree of international dependency occurred from intra-industry trade within the Asia-Pacific region(Yano, Kosaka)[20], industrial skyline analysis in ASEAN (Kuwamori)[9], international dependencies of industrial structure in Asian countries (Okamoto, Inomata, Kuwamori, Meng, Nakamura, and Sato) [15]etc, which are found to be comprehensively examined from various point of view. As regards (2), these are international dependency in GMS economy in case of Thailand and Vietnam (Kim, Secretaro, and Kaneko)[8] and China, Thailand, and Lao PDR (Kaneko, Kim, Secretaro)[7] though we do not find these are comprehensively examined because of inadequate statistical data. Also we do not find the analysis of interdependencies related to Myanmar.

3. FRAMEWORK

The TNIIO table, as configured in Fig. 1, is of the Isard-type model that traces inter-sectoral economic flows, intra-nationally and inter-nationally alike.[5][6][14] The TNIIO table also contains a third country – the Rest of the World (ROW) – that represents all areas outside the three countries under study. The (money) flows are valued at producers' prices. The symbolic representations used in Fig. 1 are defined as follows:

label of Country, C: China, T: Thailand, M: Myanmar,

$X^{SS.}$: n x n transactions of Country's products consumed in production of Country's own products, F: n x o transactions of Country's products consumed by Country's own final demand, $E^{(C \text{ or } T \text{ or } M)\ W}$: Column vector of exports of Nation's products to ROW (all nations except Thailand and Myanmar), $X^{S.}$: Column vector of gross product output of Country, IM^{WC}: Row vector of imports from ROW used in production of China's products, IM^{WT}: Row vector of imports from ROW used in production of Thailand's products, IM^{WM}: Row vector of imports from ROW used in production of Myanmar's products, FM^{WC}: Row vector of imports from ROW consumed by China's final demand, FM^{WT}: Row vector of imports from ROW consumed by Thailand's final demand, FM^{WM}: Row vector of imports from ROW consumed by Myanmar's final demand, $-M^{W}$: Total imports from ROW (as negative entry), IDT^{C} : Row vector of tariff duties of China's intermediate imports from ROW, IDT^{T}: Row vector of tariff duties of Thailand's intermediate imports from ROW, IDT^{L}: Row vector of tariff duties of Myanmar's intermediate imports from ROW, FDT^{C}: Row vector of tariff duties of China's final imports from ROW, FDT^{T}: Row vector of tariff duties of Thailand's final imports from ROW, FDT^{M}: Row vector of tariff duties of Myanmar's final imports from ROW, -DT : Total tariff duties incurred on total imports from ROW (as negative entry), V^{C} : Row vector of gross value added generated in production of China's products, V^{T} : Row vector of gross value added generated in production of Thailand's products, V^{M} : Row vector of gross value added generated in production of Myanmar's products, ROW: Rest of World.

Fig. 1 can be used to form the following balancing equations, in a three countries' economy, shown in matrix form:

$$X^{C} = X^{CC} + X^{CT} + X^{CM} + F^{CC}$$

$$+ F^{CT} + F^{CM} + E^{CW} \quad (1)$$

$$X^T = X^{TC} + X^{TT} + X^{TM} + F^{TC} + F^{TT} + F^{TM} + E^{TW} \quad (2)$$

$$X^M = X^{MC} + X^{MT} + X^{MM} + F^{MC} + F^{MT} + F^{MM} + E^{MW} \quad (3)$$

The first term on the right hand side of equation (1) represents intermediate consumption of products of China by its (China) own production sectors, the second term represents the trade flows of products of China to Thailand for intermediate consumption, the third term denotes the trade flows of China to Myanmar for intermediate consumption, the fourth, fifth and sixth terms represent the sales of the output of China to its own domestic final demand, to Thailand and to Myanmar final demands, respectively, while the last term represents the exports of China to the ROW, i.e. all areas outside the three countries' territorial limits. An analogous explanation applies to equations (2) and (3).

Using Leontief's assumption of linearity or first-order homogeneity in the production functions, we can define the following national input coefficients in matrix form:

$$A^{CC} = X^{CC}(X^C)^{-1} \quad (4)$$

$$A^{CT} = X^{CT}(X^T)^{-1} \quad (5)$$

$$A^{CM} = X^{CM}(X^M)^{-1} \quad (6)$$

$$A^{TC} = X^{TC}(X^C)^{-1} \quad (7)$$

$$A^{TT} = X^{TT}(X^T)^{-1} \quad (8)$$

$$A^{TM} = X^{TM}(X^M)^{-1} \quad (9)$$

$$A^{MC} = X^{MC}(X^C)^{-1} \quad (10)$$

$$A^{MT} = X^{MT}(X^T)^{-1} \quad (11)$$

$$A^{MM} = X^{MM}(X^M)^{-1} \quad (12)$$

Substituting these structural equations into equations (1), (2) and (3), we have:

$$X^C = A^{CC}X^C + A^{CT}X^T + A^{CM}X^M + F^{CC} + F^{CT} + F^{CM} + E^{CW} \quad (13)$$

$$X^T = A^{TC}X^C + A^{TT}X^T + A^{TM}X^M + F^{TC} + F^{TT} + F^{TM} + E^{TW} \quad (14)$$

$$X^M = A^{MC}X^C + A^{MT}X^T + A^{MM}X^M + F^{MC} + F^{MT} + F^{MM} + E^{MW} \quad (15)$$

Combining equations (13), (14) and (15), we have:

$$\begin{pmatrix} X^C \\ X^T \\ X^M \end{pmatrix} = \begin{pmatrix} A^{CC} & A^{CT} & A^{CM} \\ A^{TC} & A^{TT} & A^{TM} \\ A^{MC} & A^{MT} & A^{MM} \end{pmatrix} \begin{pmatrix} X^C \\ X^T \\ X^M \end{pmatrix} + \begin{pmatrix} Y^C \\ Y^T \\ Y^M \end{pmatrix} = \begin{pmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{pmatrix} \begin{pmatrix} A^{CC} & A^{CT} & A^{CM} \\ A^{TC} & A^{TT} & A^{TM} \\ A^{MC} & A^{MT} & A^{MM} \end{pmatrix} \begin{pmatrix} Y^C \\ Y^T \\ Y^M \end{pmatrix} \quad (16)$$

where: $Y^C = F^{CC}+F^{CT}+F^{CM}+E^{CW}$,

$Y^T = F^{TC}+F^{TT}+F^{TM}+E^{TW}$,

and $Y^M = F^{MC}+F^{MT}+F^{MM}+E^{MW}$

In order to be able to measure the spillover and feedback effects due to international trade, Round (2001) decomposed the Leontief inverse matrix **B**, thus rewriting equation (16) into the following form :

$$\begin{pmatrix} X^C \\ X^T \\ X^M \end{pmatrix} = \begin{pmatrix} B^{CC} & B^{CT} & B^{CM} \\ B^{TC} & B^{TT} & B^{TM} \\ B^{MC} & B^{MT} & B^{MM} \end{pmatrix} \begin{pmatrix} Y^C \\ Y^T \\ Y^M \end{pmatrix} = \begin{pmatrix} F^C & 0 & 0 \\ 0 & F^T & 0 \\ 0 & 0 & F^M \end{pmatrix} \begin{pmatrix} I & S^{CT} & S^{CM} \\ S^{TC} & I & S^{TM} \\ S^{MC} & S^{MT} & I \end{pmatrix} \begin{pmatrix} M^C & 0 & 0 \\ 0 & M^T & 0 \\ 0 & 0 & M^M \end{pmatrix} \begin{pmatrix} Y^C \\ Y^T \\ Y^M \end{pmatrix} \quad (17)$$

where: $\mathbf{M^C = (I - A^{CC})^{-1}}$, $\mathbf{S^{CT} = M^C A^{CM}}$,

$\mathbf{S^{CL} = M^C A^{CM}}$, $\mathbf{F^C = (I - S^{CT} S^{CM})^{-1}}$

$\mathbf{M^T = (I - A^{TT})^{-1}}$, $\mathbf{S^{TC} = M^T A^{TC}}$,

$\mathbf{S^{TM} = M^T A^{TM}}$, $\mathbf{F^T = (I - S^{TC} S^{TM})^{-1}}$

$\mathbf{M^M = (I - A^{MM})^{-1}}$, $\mathbf{S^{MC} = M^M A^{MC}}$,

$\mathbf{S^{MT} = M^M A^{MT}}$, $\mathbf{F^M = (I - S^{MC} S^{MT})^{-1}}$

The unknowns **M, S** and **F** account for the intra-regional linkages, inter-regional spillover and feedback effects, respectively.[11)]

Fig. 1 Layout of the TNIIO table linking China, Thailand, and Myanmar

From to			China	Thailand	Myanmar	TID	China	Thailand	Myanmar	ROW		TFD	Total Gross Output
			1 j n	1 j n	1 j n		1 k o	1 k o	1 k o	E	M		
Intermediate Inputs	China	1 i n	X^{CC}	X^{CT}	X^{TM}	Demand Intermediate Total	F^{CC}	F^{CT}	F^{CM}	E^{CW}	0	Final Demand Total	X^C
	Thailand	1 i n	X^{TC}	X^{TT}	X^{TM}		F^{TC}	F^{TT}	F^{TM}	E^{TW}	0		X^T
	Myanmar	1 i n	X^{MC}	X^{MT}	X^{MM}		F^{MC}	F^{MT}	F^{MM}	E^{MW}	0		X^M
	ROW		IM^{WC}	IM^{WT}	IM^{WM}		FM^{WC}	FM^{WT}	FM^{WM}	0	$-M^W$		0
	D T		IDT^C	IDT^T	IDTM		FDT^C	FDT^T	FDT^M	0	-DT		0
TII			Total Intermedite Inputs			$\sum$	F^C	F^T	F^M	$\sum E^W$	$-\sum M^W$	$\sum$	$\sum X$
Gross Value Added			V^C	V^T	V^M	$\sum$							
Total Gross Input			$X^{C'}$	$X^{T'}$	$X^{M'}$	$\sum X'$							

4. METHODOLOGY AND DATA SOURCES

To carry out the general objective of this study, an empirical exercise was conducted, taking into consideration the conceptual and accounting framework of TNIIO table as described in Section 3. For this initial attempt, the chosen period of reference was calendar year 2005 because the latest data relevant to the study were already available, namely: (1) the 2005 Asian international IO table including **China** and **Thailand** has already been published by IDE-JETRO[4)], and (2) the compilation by the study team of a 2005 IO table for **Myanmar's** economy, given available information primarily on its foreign trade statistics with the ROW.

[STEP-1] Compilation of a national IO table for Myanmar

Existing data constraints did not allow for a direct compilation of a Myanmar IO table using IO survey data. Based on a new estimated input-output table (2000-2001) for Myanmar by Thwin, Yoshida, and Maeda, we compiled a 10-sector IO table for Myanmar by adopting the non-survey approach with 2005 as the reference year. For comparability, the table is uniformly valued in US dollars at current producers' prices. In addition official exchange rate was too underestimated to adopt. So we adopted real exchange rate[*3].

[STEP-2] Reconstruction of the 2005 bilateral IO table for China and Thailand

For the general purpose of this study, the 2005 Asian international IO (AIO) table was first reconstructed and second reduced in size to be consistent with the Myanmar's 10-sector table separately prepared by the study team. The bilateral IO table for China and Thailand was reconstructed from the 2005 AIO table by forming a symmetric IO table in 10-sector dimensions wherein cell elements were separately accounted for the imported from the locally-produced goods and services. The table is then valued in US dollars at current producers' prices.

[STEP-3] Estimation of bilateral trade flows

From the reconstructed 2005 AIO table as shown in STEP 2, we can find Thailand export is divided into China and ROW which includes Myanmar. Then the ROW of Thailand's export column has to be subdivided into 2 sub-columns; a sub-column for export to Myanmar and another for export to ROW except Myanmar. The same subdivision procedure is done for the import columns. The source of data basically comes from each country's statistics on foreign trade by commodity and by country of origin and destination. In the absence of direct information on the import contents of intermediate and final demand transactions specifically on Thailand's & Myanmar's bilateral trade, the estimation of international trade flows was done indirectly by using calculated bilateral trade coefficients. On the other hand, the estimation of bilateral trade flows between China and Myanmar is analogously calculated.

[STEP-4] Developing the Integrated TNIIO table

By combining a national IO table for Myanmar and the international bilateral IO table for China and Thailand into one tabular lay-out as earlier shown in Fig. 1 and by adjusting and reconciling the combined IO table, the TNIIO table linking China, Thailand and Myanmar is formed.

5. MAIN RESULTS AND APPLICATIONS

This chapter describes and explains the key results from the viewpoint of economic interdependence based on the TNIIO table. The findings of applications such as multiplier, linkage as well as the spillover and feedback effects are presented and analyzed, taking into consideration the 10-sector aggregations of the table.

(1) Comparative Analysis of Economic Structures

a) Supply And Demand

In 2005, the available supply of goods and services amounted to US$7,395.5 billion in China, US$615.8 billion in Thailand, and a mere US$27.0 billion in Myanmar, or a total of US$8,038.3 billion for the three economies under study. The China's economy provides the biggest bulk of the available supply accounting for 92.0 %, with Thailand and Myanmar accounting for the remaining 8.0 %.

In terms of sources of supply, domestic production shared the greater share in three countries, with China accounting for 90.2%, Thailand for 77.0% and Myanmar for 92,7%. Thailand's economy is therefore more dependent on imports than China and Myanmar, with imports comprising 23.0% of its total supply, against china's 9.8% and Myanmar's 7.3% import share.

From the demand side, Table 1 shows that, compared to Thailand, domestic demand in China and Myanmar accounted for a higher proportion of its respective total demand – 87.9% and 87.4% as against 79.0% in Thailand. It goes to show that Thailand is relatively an export-oriented economy than China's economy with Thailand exports accounting for 21.0% much higher than the 12.1% of China's exports. The table also shows Myanmar's export share is much lower than Thailand's.

It can be observed that, while China's intermediate demand share (59.5% of total demand) is much higher than Thailand's (45.7%) and Myanmar's (48.3%), the proportion of Myanmar's final domestic demand (39.1%) is higher than Thailand's (33.3%) and China's(28.4%). It appears that, in the consumption, Myanmar's economy exhibited higher shares than Thailand's and China's.

Table 1 Overview of Supply and Demand, 2005

Unit: US $ Million

	China	%	Thailand	%	Myanmar	%	Total	%
supply	7,395,479.1	100.0	615,784.8	100.0	27,001.1	100.0	8,038,265.0	100.0
A)production	6,672,500.5	90.2	474,314.1	77.0	25,024.4	92.7	7,171,839.0	89.2
B)import	722,978.6	9.8	141,470.7	23.0	1,976.7	7.3	866,426.0	10.8
demand	7,395,479.1	100.0	615,784.8	100.0	27,001.1	100.0	8,038,264.9	100.0
A) domestic demand	6,500,662.0	87.9	486,406.5	79.0	23,597.8	87.4	7,010,666.3	87.2
1)intermediate	4,399,505.1	59.5	281,374.1	45.7	13,037.2	48.3	4,693,916.4	58.4
2)final	2,101,156.9	28.4	205,032.4	33.3	10,560.6	39.1	2,316,749.9	28.8
a)consumption	1,193,789.5	16.1	141,339.3	23.0	9,023.8	33.4	1,344,152.6	16.7
b)investment	907,367.5	12.3	63,693.1	10.3	1,536.8	5.7	972,597.4	12.1
B)export	894,817.1	12.1	129,378.3	21.0	3,403.3	12.6	1,027,598.6	12.8

b) Gross Output Structures

As shown in Table 2 below, we can observe the different production patterns by sector among the three countries under consideration. In 2005, about half of its total gross output in **China and Thailand** was concentrated in **manufacturing and repair sector** (50.7% and 49.0%, respectively) as against 38.8% in **Myanmar's** economy. On the other hand, the **agriculture, fishery & forestry sector** of its total gross output in **Myanmar** contributed a much higher share (28.1%) than China's (6.9%) and Thailand's (5.7%). In short, we can say that Myanmar economy is still largely agricultural while China and, maybe, Thailand economies are industrialized.

Table 2 Comparative Gross Output Structures by Sector, 2005

Unit: US $Million

sector	China	%	Thailand	%	Myanmar	%	Total	%
Agriculture,forestry,and Fishery	463,680	6.9	26,986	5.7	7,024.1	28.1	497,689.7	6.9
Minig and quarrying	237,619	3.6	7,673	1.6	149.2	0.6	245,440.9	3.4
Manufacturing and repair	3,383,710	50.7	232,341	49.0	9,717.3	38.8	3,625,767.6	50.6
Electricity , Gas ,and WaterSupply	246,054	3.7	19,663	4.1	39.2	0.2	265,756.0	3.7
Construction	519,455	7.8	16,056	3.4	1,721.6	6.9	537,232.1	7.5
Trade	290,535	4.4	54,832	11.6	3,536.6	14.1	348,903.1	4.9
Transportation and Communication	393,276	5.9	30,748	6.5	2,374.5	9.5	426,399.0	5.9
Banking and Insurance	125,229	1.9	11,874	2.5	16.0	0.1	137,118.7	1.9
Personal Services etc	856,564	12.8	52,075	11.0	233.1	0.9	908,871.8	12.7
Public Services	156,379	2.3	22,068	4.7	212.7	0.9	178,660.0	2.5
All sectors	6,672,500	100.0	474,314	100.0	25,024.4	100.0	7,171,839.0	100.0

c) Intermediate Input Structures

At the aggregate level, the intermediate input ratio of Myanmar was lower than that of China and Thailand though each ratio was over 50%. Table 3 shows that, in China's, Thailand's and Myanmar's productive economy, 65.9, 59.3, and 52.1 cents for every dollar of total gross input (= production cost) in 2005 went respectively to the purchase of intermediate inputs, with the remainder going to primary input payments or what is popularly known as gross value added (GVA) to the economy.

In the three countries, **manufacturing and repair** shows a rather high proportion of their total (domestic and import) intermediate inputs. Besides Thailand was found to be highly dependent on imports. In contrast, the intermediate ratio of agriculture, forestry, and fishery in Myanmar was much lower than that in China and Thailand. Also in electricity, gas, and water supply and personal services, we find Myanmar to be much different from China and Thailand. As mentioned above, we can identify the feature and difference by comparing the economic scale, the industrial structure, and the dependence on import among the three countries.

Table 3 Comparative Intermediate Input Ratios by Sector by Source, 2005

Unit: %

sector	China			Thailand			Myanmar		
	intermediate ratio	ratio of domestic to total	ratio of import to total	intermediate ratio	ratio of domestic to total	ratio of import to total	intermediate ratio	ratio of domestic to	ratio of import to total
Agriculture,forestry,and Fishery	41.3	97.0	3.0	39.0	85.1	14.9	20.3	89.2	10.8
Minig and quarrying	53.4	96.0	4.0	33.0	95.8	4.2	41.5	99.6	0.4
Manufacturing and repair	77.0	83.6	16.4	74.3	51.2	48.8	84.2	95.1	4.9
Electricity , Gas ,and WaterSupply	65.3	87.1	12.9	58.4	81.4	18.6	31.1	95.7	4.3
Construction	74.4	94.1	5.9	76.8	71.6	28.4	73.8	93.8	6.2
Trade	47.2	94.2	5.8	19.2	96.0	4.0	26.4	98.7	1.3
Transportation and Communication	53.5	93.7	6.3	59.7	94.1	5.9	42.0	98.5	1.5
Banking and Insurance	38.5	93.4	6.6	29.2	98.6	1.4	38.0	100.0	0.0
Personal Services etc	53.7	92.5	7.5	49.2	88.7	11.3	17.7	90.2	9.8
Public Services	46.7	92.8	7.2	63.3	99.3	0.7	48.4	96.0	4.0
All sectors	65.9	87.6	12.4	59.3	65.9	34.1	52.1	94.8	5.2

(2) International Analysis and Applications

In terms of the economic interdependencies among the three countries, the findings of applications such as multiplier, linkage and impact analyses as well as spillover and feedback effects are analyzed.

a) Backward and Forward Linkages

Linkages reflect the dependence of industries on one another in an economy and measure the potential stimulus that will be induced in other industries arising from an increase in activity in a particular industry. A Backward Linkage (BL) is a measure of the relative importance of an industry as a user of inputs from the entire production system. It measures the output increases which will occur in industries which supply inputs to the industry concerned. A BL can be computed as the ratio of the sum of the elements of a column of the Leontief inverse to the average of the whole system. This ratio is described by Rasmussen (1957) [13)]as the index of the power of dispersion, μ_j , and is defined mathematically as:

$$\mathbf{BL}:\boldsymbol{\mu}_j = \frac{\frac{1}{n}\sum_{i=1}^{n} b_{ij}}{\frac{1}{n}\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} \qquad (18)$$

where the b_{ij} is the element of the international Leontief inverse. b_{ii} is the diagonal element of the international Leontief inverse. The higher the value of μ_j , the stronger is the influence of production sector j as a user of intermediate inputs. It tends that the column sum of inverse matrix coefficient grows big so as to be high if a intermediate input share is high and "the own sector's input" that is the business between equivalence sections be included in middle injection, and there is the method except "own section injection" in the calculation of "the influence coefficient" because it greatly controls middle injection rate.

A Forward Linkage (FL) indicates the relative importance of an industry as a supplier of inputs to the entire production system. It measures the output increases which will occur in industries which use the inputs supplied by the industry concerned. A FL can be expressed as the ratio of the sum of the elements along a row of the Leontief inverse to the average of the entire system. This ratio is likely described by Rasmussen (1957) as the index of sensitivity. This ratio is described by Rasmussen (1957) as the index of sensitivity, μ_i and is defined mathematically as:

$$\mathbf{FL}:\boldsymbol{\mu}_i = \frac{\frac{1}{n}\sum_{j=1}^{n} b_{ij}}{\frac{1}{n}\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} \qquad (19)$$

The higher the value of μ_i , the greater is the influence of production sector i as a supplier of intermediate inputs to the entire production system.

The international linkages in our study are presented in Table 4 below. As can be seen, the estimated values of the backward linkages in Myanmar and Thailand appear to be relatively quite low compared to China where most sectors registered backward linkages of more than unity. Eight out of ten sectors in China, three in Thailand and four in Myanmar exhibited backward linkages greater than unity in 2005.

In the case of forward linkages, four out of ten sectors in China, two in Thailand, and three in Myanmar had indexes higher than unity. These sectors primarily provide the supply

requirements of the inputs needed by the economies in their production activities.

Table 4 International Backward & Forward Linkage Effects: China, Thailand, and Myanmar,2005

	China		Thailand		Myanmar	
sector	Backward Linkage	Forward Linkage	Backward Linkage	Forward Linkage	Backward Linkage	Forward Linkage
Agriculture,forestry,and Fishery	0.9830	0.959	0.8176	0.739	0.7004	1.824
Minig and quarrying	1.1490	1.057	0.8102	0.749	0.9990	0.591
Manufacturing and repair	1.3316	3.654	0.8975	1.882	1.1715	2.036
Electricity , Gas ,and WaterSupply	1.1961	0.987	0.9450	0.823	0.8716	0.533
Construction	1.4001	0.623	1.0421	0.538	1.2738	0.900
Trade	1.0567	0.874	0.6921	0.846	0.8154	0.935
Transportation and Communication	1.1419	1.066	1.0445	0.860	1.0092	1.075
Banking and Insurance	0.9461	0.723	0.7804	0.760	0.9617	0.527
Personal Services etc	1.1348	1.201	0.9167	1.132	0.6965	0.529
Public Services	1.0450	0.526	1.1018	0.526	1.0686	0.526

Industries with linkages greater than or equal to unity are defined as industries with high interdependence, while those with linkages below unity are considered as industries with low interdependence. Based on these definitions, Chenery and Clark (1959) [3]classified industries into the following four groups:

GROUP I: HIGH BL, HIGH FL,
GROUP II: HIGH BL, LOW FL,
GROUP III: LOW BL, HIGH FL,
GROUP IV: LOW BL, LOW FL,

Industries which belong to Groups I and II are those whose production processes are characterized by relatively high usage of intermediate inputs. An expansion in these industries would have a considerable impact on the whole economic system. This is particularly so for industries in Group I since, in addition to having high values of FL, they are also characterized by large values of BL, which means that a major portion of their outputs is also absorbed by the system.

Industries classified under Groups III and IV is both characterized by low values of BL as they tend to maintain a cost structure which is biased towards the use of primary inputs rather than intermediate inputs. In addition, industries which belong to Group IV do not depend extensively on the system of productive sectors for their intermediate input requirements, while their products are not utilized much by other industries as they are mainly channeled directly to final consumption.

The classification of industries in this manner is particularly useful to economic planners and policy makers in the assessment and setting of industrial priorities in regional development. For example, industries under Group I could be considered the top priority industries in development policy due to their high linkages with the productive system as users and providers of inputs.

Grouping the sectors in our study, as shown in Table 5, reveals that four out of ten sectors in China belong to Group I though no sectors in Thailand and two out of ten sectors in Myanmar belong to Group I. Also five out of ten sector both in Thailand and Myanmar belong to Group Ⅳ. We can find the large difference among the three countries because of the different industrial structure and development stage. Only three sectors (Construction, banking and

insurance, and public services) in each country belong to same Group.

Table 5 Grouping of Sectors based on degrees of International Linkage Effects,2005

China

		Forward Linkage	
		HIGH	LOW
Backward Linkage	HIGH	GROUP Ⅰ Minig and quarrying Manufacturing and repair Transportation and Communication Personal Services etc	GROUP Ⅱ Electricity , Gas ,and WaterSupply Construction Trade Public Services
	LOW	GROUP Ⅲ	GROUP Ⅳ Agriculture,forestry,and Fishery Banking and Insurance

Thailand

		Forward Linkage	
		HIGH	LOW
Backward Linkage	HIGH	GROUP Ⅰ	GROUP Ⅱ Construction Transportation and Communication Public Services
	LOW	GROUP Ⅲ Manufacturing and repair Personal Services etc	GROUP Ⅳ Agriculture,forestry,and Fishery Minig and quarrying Electricity , Gas ,and WaterSupply Trade Banking and Insurance

Myanmar

		Forward Linkage	
		HIGH	LOW
Backward Linkage	HIGH	GROUP Ⅰ Manufacturing and repair Transportation and Communication	GROUP Ⅱ Construction Public Services
	LOW	GROUP Ⅲ Agriculture,forestry,and Fishery	GROUP Ⅳ Minig and quarrying Electricity , Gas ,and WaterSupply Trade Banking and Insurance Personal Services etc

b) Spillover and Feedback Effects

A single-national IO table essentially assumes that imports from suppliers and exports to buyers outside the economy are treated as exogenous. However, such a table will not allow us to capture the international economic spillover and feedback effects in an economic system. These effects can be illustrated as follows. Suppose there is an increase in demand by the ROW for the products of the manufacturing industry in China. This will result in an increase in the output of the manufacturing industry in China, which could result in an increase in demand for relevant inputs from suppliers outside the country, say, Thailand. This new demand for the output of the suppliers in Thailand will create an increase in their output and, directly and indirectly, the output of other industries in Thailand. This stimulus of new output in Thailand due to new output in China is known as the international spillover effect. In addition, suppose that the stimulated production in Thailand includes increased output of industries that use inputs from China in their production process. Thus, the increased manufacturing production in Thailand leads to increased output of its suppliers in Thailand, which, in turn, leads to more production in China. This is known as the international feedback effect. Also the same correspondence, which is analogously calculated, can be said between China and Myanmar and between Myanmar and Thailand. These spillover and feedback effects are computed using the formula shown in equation (17).

Table 6 shows that, because of weak international linkages among countries and between sectors, the estimated spillover and feedback effects mostly appear to be insignificant. Especially, feedback effects between the three countries are found to be very negligible. Under such circumstances, the spillover effect of manufacturing and repair in Thailand to China is in some degree significant. Also, the spillover effect of agriculture, forestry, and fishery and manufacturing and repair in Myanmar to China is likewise found to be in some degree significant.

Table 6 International Spillover and Feedback Effect,2005

	SPILLOVER EFFECT						FEEDBACK EFFECT		
	From China		From Thai		From Myanmar		F^{C}	F^{T}	F^{M}
Sector	To Thai	To Myanmar	To China	To Myanmar	To China	To Thai	To China	To Thai	To Laos
Agriculture,forestry,and Fishery	0.000641	0.000140	0.006432	0.001905	0.022226	0.009300	0.000022	0.000041	0.000068
Minig and quarrying	0.001414	0.000126	0.002766	0.002212	0.001181	0.000494	0.000028	0.000013	0.000001
Manufacturing and repair	0.009840	0.001222	0.076927	0.016027	0.021878	0.009155	0.000307	0.000432	0.000020
Electricity , Gas ,and WaterSupply	0.000593	0.000069	0.003042	0.000635	0.000113	0.000047	0.000017	0.000017	0.000000
Construction	0.000056	0.000007	0.000071	0.000016	0.005289	0.002213	0.000002	0.000000	0.000005
Trade	0.000873	0.000117	0.011916	0.001713	0.008261	0.003457	0.000031	0.000063	0.000010
Transportation and Communication	0.000809	0.000088	0.004770	0.000714	0.009033	0.003780	0.000025	0.000024	0.000016
Banking and Insurance	0.000198	0.000025	0.002097	0.000419	0.000028	0.000012	0.000006	0.000012	0.000000
Personal Services etc	0.000667	0.000082	0.002716	0.000702	0.000065	0.000027	0.000020	0.000015	0.000000
Public Services	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Total	0.015093	0.001876	0.110737	0.024344	0.068074	0.028486	0.000458	0.000616	0.000120
Average	0.001509	0.000188	0.011074	0.002434	0.006807	0.002849	0.000046	0.000062	0.000012

c) Impact on Import Requirements

The non-competitive type of IO table such as this 2005 TNIIOT enables the quantification and assessment of the total imports from ROW needed by sector to sustain final demands. The total import requirements induced by the categories of final demand are obtained using the matrix equation:

$$\mathbf{M} = \hat{\mathbf{\Pi}}\mathbf{X}$$

where $\mathbf{M}$ is the matrix of total (direct + indirect) intermediate import requirements induced by final demand; $\hat{\mathbf{\Pi}}$ is diagonal

matrix of total imported intermediate input coefficients which is the sum of imported goods and services plus its customs duties levied, and $\mathbf{X}$ is matrix of total output requirements induced by final demand.

Table 7 shows the total (direct and indirect) import requirements by producing sectors to sustain the final demands in each country. The table shows the values of total imports inclusive of customs duties induced by each category of final demand in each of the countries under study. For example, China's total imports from ROW amounted to US$535.0 billion broken down as follows: US$140.3 billion to sustain its private consumption expenditure demand, US$37.3 billion to sustain its government consumption expenditure demand, US$167.9 billion to sustain its gross fixed capital formation demand, US$2.4 billion to sustain its increase in stock demand, and US$199.7 billion to satisfy its exports demand. Given the predetermined values of each final demand component, we can solve for the import multipliers, expressed as imports induced to satisfy a unit of final demand, as follows: 0.161, 0.115, 0.178,0.103, and 0.226, respectively.

On the whole, China's total imports multipliers averaged 0.179 imports for a unit of its final demand. For Thailand and Myanmar, their import multipliers are analogously calculated. The results show Thailand's production is more import dependent than China's and Myanmar as its import multiplier is exceedingly high at 0.251 per unit of its final demand. Myanmar is the least import dependent at 0.041 per unit of its final demand.

Table 7 Total Impact of Imports Required in Production to Sustain Final Demands, 2005

Unit:US Million$

Country	Induced China						
Item	Private Consumption Expenditure	Government Consumption Expenditure	Gross Fixed Capital Formation	Increase in Stock	Adjustment item	Export	Total Final Demand
Total Induced Import	140,338	37,318	167,892	2,359	-12,587	199,707	535,028
Total Final Demand	869,110	324,679	943,397	22,871	-58,901	882,134	2,983,291
Output Multiplier	0.161	0.115	0.178	0.103	0.214	0.226	0.179
Country	Induced Thailand						
Item	Private Consumption Expenditure	Government Consumption Expenditure	Gross Fixed Capital Formation	Increase in Stock	Export	Total Final Demand	
Total Induced Import	23,750	2,628	10,977	2,668	40,925	80,949	
Total Final Demand	119,260	22,079	53,018	10,675	117,395	322,427	
Output Multiplier	0.199	0.119	0.207	0.250	0.349	0.251	
Country	Induced Myanmar						
Item	Private Consumption Expenditure	Government Consumption Expenditure	Gross Fixed Capital Formation	Increase in Stock	Export	Total Final Demand	
Total Induced Import	345	8	74	3	46	476	
Total Final Demand	8,811	213	1,477	60	1,117	11,678	
Output Multiplier	0.039	0.036	0.050	0.046	0.042	0.041	

One interesting observation of the results is the multiplier effect of export demand on intermediate import requirements. While the import content of the production of goods and services for export cannot be directly measured from the basic IO table, it can be indirectly estimated as can be observed in Table 7. In China's economy, its total import requirements induced by exports demand amounted to US$199.7 billion in 2005, which is then divided by its total export value of US$882.1 billion to yield an inducement coefficient or import multiplier of 0.226. In plain language, the finding suggests that, in order to sustain US$1,000 worth of demand for export goods and services, China's production sectors need to import US$226 worth of intermediate inputs. In short, China's net foreign exchange earning thus amounts to only US$774, calculated as the gross export receipt of US $1,000 less the import "leakage" of US$226.

Estimation procedure used above is analogously applied in the case of Thailand's export-induced total import multiplier effect of 0.349. It can thus be concluded that Thailand's export-oriented products tended to be much import-dependent than China's. Its net foreign exchange income is therefore estimated as US$1,000 gross export receipts minus its import "leakage" of US$349 or a net of a lower US$ 651, much less than what China receives from its net exports as calculated above. On the other hand, Myanmar's export-induced total import multiplier effect is a lower 0.042, meaning its net foreign exchange earning amounts to a extremely more US$958 per US$1,000 gross export receipts.

6. CONCLUSION

Summarized below are the arguments presented in this paper.

(1) Our paper has developed a TNIIO model that links the neighboring economies of China, Thailand, and Myanmar. And the extent of economic interdependence among and between industries of the three countries could be showed by the TNIIO model.

(2) The economic interdependencies linking China, Thailand and Myanmar in the year 2005 were very weak in terms of the great difference of economic development stage or industrial structure in spite of the remarkable traffic development.

(3) Import analysis revealed that Myanmar's export-oriented products were found to be much less import-dependent than Thailand's and China's, thus resulting in more net foreign exchange receipts to its economy relative to what Thailand and China receive because of their higher import "leakages" in the production of export products.

Above all, we can clearly identify the interdependencies among three countries. However, if the free trade will be blindly promoted among three countries, the rich natural or human resources of low underdeveloped countries is apprehensive of the one-sided plunder. So it is necessary to seek to satisfy the mutual prosperity in coexistence among three countries.

Footnotes

*1 The Greater Mekong Sub-region comprises Cambodia, the People's Republic of China (China, specifically, Yunnan Province and Guangxi Zhuang Autonomous Region,where geographically neighbour to Lao PDR or

Myanmar or Vietnam), Lao PDR, Myanmar, Thailand, and Vietnam.

*2 In 1992, with ADB's assistance, the six countries of GMS entered into a program of sub-regional economic cooperation, designed to enhance economic relations among the countries through the kinds of development. We can approximately find a total of 320 million people and 491.0 million US$ in gross domestic product (GDP) in this sub-region in 2005. In addition, this total means the value of Cambodia, Yunnan Province and Guanguxi Zhuang Autonomous Region in China, Lao PDR, Myanmar, Thailand, and Vietnam.

*3 Average of period in CY 2005 (World Bank Statistics)

1US$=1,025 Kayt (Myanmar) not official rate but real rate of exchange based on International Monetary Fund (IMF) World Economic Outlook Statistics

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