Developing a Bilateral Input-Output Table in the Case of Thailand and Vietnam: Methodology and Applications

Dr. Kim Kwangmoon*
Mr. Francisco Secretario**
Mr. Bui Trinh**
Mr. Hidefumi Kaneko***

This paper attempts to measure and analyze the interdependent economic relations between the countries of Thailand and Vietnam, made possible by constructing a bilateral input-output (I-O) table linking the said two countries. It is an inter-regional type of I-O models that provides a compact and comprehensive accounting framework to quantify the economic inter-relationships among and between industries located in the study regions.

This study is deemed to be a prototype of what the Association of Regional Econometrics and Environmental Studies (AREES) needs to support its ongoing efforts to develop an integrated database for its proposed research project, entitled: "Impact Analysis of Infrastructure Investment in the Indochina Region: An Input-Output (I-O) Approach". One interesting observation of the results is the multiplier effect of export demand on the import requirements in production. While the import content of the production of export-oriented commodities cannot be directly measured from the I-O table, impact analysis revealed that production of export goods and services in Thailand was found to be more import-dependent than in Vietnam's. It can thus be concluded that, in terms of net foreign exchange earnings, which is estimated as the difference between gross export receipts and calculated import "leakages", appeared to be relatively more beneficial to Vietnam's economy than to Thailand's.

Keyword: International IO table, Indochina Region.

*Associate Professor, Kyoto University/ Principal Fellow, AREES
kimkwangmoon@toshi.kuciv.kyoto-u.ac.jp
**Principal Fellow, AREES
***Vice President, AREES

I. INTRODUCTION

In the last 10 years, Indochina's economy has consistently experienced high economic growth. International trade liberalization has likely influenced a significant impact on the Indochina region. This has prompted recent interest in measuring the total economic impacts [on production, employment, income] on the region's national economies. This paper attempts to measure and analyze the interdependent economic relations between the countries of Thailand and Vietnam, made possible by constructing a bilateral input-output (I-O) table linking the said two countries. It is an inter-regional type of I-O models that provides a compact and comprehensive accounting framework to quantify the economic inter-relationships among and between industries located in the study regions.

Similar to a single-region (national) IO table, an Inter-Regional IO (IRIO) table can be used to estimate the magnitude of an external "shock" on major macroeconomic indicators such as output, value-added, income and employment. However, unlike its single-region counterpart, an IRIO (or INIO) table is able to capture and assess the inter-regional spillover and feedback effects arising from an exogenous change in demand for the output of any one of the study regions. In other words, constructing an IRIO table will not only allow us to estimate the stimulus to production outside the study region benefiting from, say, an increase in foreign demand for its output, but also the resultant impact on its output arising from the production stimulus it causes in the other study regions.

This study is deemed to be a prototype of what the Association of Regional Econometrics and Environmental Studies (AREES) needs to support its ongoing efforts to develop an integrated database for its proposed research project, entitled: "Impact Analysis of Infrastructure Investment in the Indochina Region: An Input-Output (I-O) Approach".

The paper is structured as follows: Section II overviews the current status of IO compilation in Indochina region. Section III outlines the accounting framework used to develop the IRIO table. The methods and data used to construct the 2000 Thailand-Vietnam IRIO table are described in Section IV before we discuss the salient findings of the study in Section V. Finally, Section VI concludes.

II. Overview of IO compilation in Indochina countries.

Generally, Indochina covers the countries of Thailand, Vietnam, Lao PDR, Cambodia, Myanmar, Yunnan-Guǎngxī Province of China.

Thailand has produced benchmark national Input Output (IO) table since 1975, and it has been compiled regularly every five years. Its first IO table is compiled by the office of the National Economic and Social Development Board (NESDB) in cooperation with Chulalongkorn University, the National Statistical Office (NSO), and the Institute of Developing Economies (IDE), Japan. Thailand has also been one of 10 partner countries

involved in the periodic compilation of Asia international IO (AIO) table as a continuing project of IDE since it started in the 70's. The latest national IO table is year 2005. AREES has compiled several regional IO tables used as databases for conduct of cross border economic studies as the regional level under ADB project.

Since ~~it's~~ its accounting shift from MPS to UN-SNA in the late 1980's, Vietnam has produced benchmark national IO table since 1989, and it has 4 tables (1989-1996-2000-2007). First IO table is compiled by office of the General Statistics Office (GSO). The latest national IO table is Year 2007. AREES has compiled several intra-regional IO tables (HCM, Hanoi, Danang, Can Tho, Haiphong, Quantri, etc) and inter-regional IO table (2 region's, 3 region's, 8 region's IRIO table.). AREES in cooperation with Nation Institute of Statistics (NIS) under Cambodia government has compiled its first Cambodia's national IO table with year 2000. NIS has recently compiled 2005 supply and use table (SUT) under one ADB-sponsored project. Given 2005 SUT, the 2005 IO table can be constructed. In Lao PDR, there is no benchmark national IO table compiled by Government. AREES in cooperation with National Statistics Center (NSC), National University of Laos (NOUL) independently constructed a national IO table with year 2003. In Myanmar, there is also no official IO table. AREES had made an initial attempt to compile an unofficial National IO table for Myanmar with year 2005 as reference year. Yunnan province, Yunnan's Provincial Statistics Bureau (Yunnan PSB) has made provincial IO table since 1987, and it has 5 tables (1987-92-97-2002-07). The latest one is year 2007.

Table-1. Summary table of latest Available (National) IO table in Indochina countries

Indochina country	Year side of IO	Methodology	Compiler
Cambodia	2003 IO/20 sector	Non Survey	AREES-NIS
	2005 SUT/48 sector		NIS
	2007 SUT/ 51 sector of industries and 32 sectors of commodities		NIS
Lao PDR	2003 IO/16 sector	Non Survey	AREES
Myanmar	2005 IO/17 sector	Non Survey	AREES
Thailand	2005 IO/ 180 sector	Survey	NESDB
Vietnam	2007 IO/ 138 sector	Survey	GSO (Trinh)
Yunnan Provinces, China	2007 Yunnan IO/ 144 sector	Survey	Yunnan PSB
	2005 China IO/ 76 sector		CSB-IDE(JETRO)

III. The THAILAND-VIETNAM IRIO FRAMEWORK

The IRIO Model

The Thailand-Vietnam bilateral IO table, as configured in Figure 1, is of the Isard-type of IRIO models that traces inter-sectoral economic flows, intra-nationally and inter-nationally alike. To complete the IRIO accounts, the model also contains a third country – the Rest of the World (ROW) – that represents all areas outside the two countries under study. The resulting IRIO table is also thus able to measure and analyze trade interdependencies between the study regions and the ROW. The (money) flows are valued at producers' prices (ie, prices net of trade and transport margins, but gross of product taxes).

FIGURE 1. CONFIGURATION OF BILATERAL (THAILAND-VIETNAM) IRIO TABLE

FROM \ TO			INTERMEDIATE DEMAND			FINAL DEMAND					
			THA	VIE	TID	THA	VIE	ROW		TFD	TGO
			1...j...n	1...j...n		1...k...o	1...k...o	E	M		
INTERMEDIATE INPUTS	THA	1 : i : n	X^{TT}	X^{TV}	TOTAL INTERMED DEMAND	F^{TT}	F^{TV}	E^{TW}	0	TOTAL FINAL DEMAND	X^{T}
	VIE	1 : i : n	X^{VT}	X^{VV}		F^{VT}	F^{VV}	E^{VW}	0		X^{V}
	IF		$^{I}IF^{T}$	$^{I}IF^{V}$		$^{F}IF^{T}$	$^{F}IF^{V}$	0	$-IF^{-}$		0
	ROW		$^{I}M^{WT}$	$^{I}M^{WV}$		$^{F}M^{WT}$	$^{F}M^{WV}$	0	$-M^{W-}$		0
	DT		$^{I}DT^{T}$	$^{I}DT^{V}$		$^{F}DT^{T}$	$^{F}DT^{V}$	0	$-DT^{-}$		0
TII			TOTAL INTERMED INPUTS		$\sum X$	F^{-T}	F^{-V}	$\sum E^{-W}$	$-\sum M^{W}$	$\sum Y$	$\sum X$
VALUE ADDED		1 : p : s	V^{T}	V^{V}	V^{-}						
TPI			GVA		$\sum V$						
TOTAL GROSS INPUT			$X^{T'}$	$X^{V'}$	$\sum X'$						

The symbolic representations used in Figure 1 are defined as follows:

$\mathbf{X^{TT}}$: n x n matrix, where each element $\mathbf{x_{ij}^{TT}}$ (accounts for the value of Thailand's product *i* consumed by its own [Thailand's] production sector *j*, where n is the number of intermediate [production] sectors and *i* = *j*) , $\mathbf{X^{TV}}$: n x n matrix, where each element $\mathbf{x_{ij}^{TV}}$ (accounts for the export value of Thailand's product *i* consumed by Vietnam's production sector j), $\mathbf{Y^{TT}}$: n x k matrix, where each element $\mathbf{y_{ik}^{TT}}$ (accounts for the value of Thailand's product *i* consumed by

its own [Thailand's] final domestic demand sector *k*), $\mathbf{Y^{TV}}$: n x k matrix, where each element $\mathbf{y_{ik}^{TV}}$ (accounts for the export value of Thailand's product *i* consumed by Vietnam's final domestic demand sector *k*), $\mathbf{E^{TW}}$: column vector, where each element $\mathbf{e_i^{TW}}$ (the value of Thailand's product *i* exported to the Rest of the World [ROW]), $\mathbf{X^{T}}$: column vector, where each element $\mathbf{x_i^{T}}$ (the gross output of Thailand's product *I),* $\mathbf{X^{VT}}$: n x n matrix, where each element $\mathbf{x_{ij}^{VT}}$ (accounts for the export value of Vietnam's product *i* consumed by Thailand's production sector j) . $\mathbf{X^{VV}}$: n x n matrix, where each element $\mathbf{x_{ij}^{VV}}$ (accounts for the value of Vietnam's product *i* consumed by its own [Vietnam's] production sector *j)* , $\mathbf{Y^{VT}}$: n x k matrix, where each element $\mathbf{y_{ik}^{VT}}$ (accounts for the export value of Vietnam's product *i* consumed by Thailand's final domestic demand sector *k),* $\mathbf{Y^{VV}}$: n x k matrix, where each element $\mathbf{y_{ik}^{VV}}$ (accounts for the value of Vietnam's product *i* consumed by its own [Vietnam's] final domestic demand sector *k),* $\mathbf{E^{VW}}$: column vector, where each element $\mathbf{e_i^{VW}}$ (the value of Vietnam's product *i* exported to the Rest of the World [ROW]), $\mathbf{X^{V}}$: column vector, where each element $\mathbf{x_i^{V}}$ (the gross output of Vietnam's product *i*), $\mathbf{^{I}IF^{T}}$: row vector, where each element $\mathbf{^{I}IF_j^{T}}$ (accounts for the total value of insurance & freight for imports of goods by Thailand's production sector j from partner country, Vietnam), $\mathbf{^{I}IF^{V}}$: row vector, where each element $\mathbf{^{I}IF_j^{V}}$ (accounts for the total value of insurance & freight for imports of goods by Vietnam's production sector j from partner country, Thailand), $\mathbf{^{F}IF^{T}}$: row vector, where each element $\mathbf{^{F}IF_k^{T}}$ (accounts for the total value of insurance & freight for imports of goods by Thailand's final domestic demand sector *k* from partner country, Vietnam), $\mathbf{^{F}IF^{V}}$: row vector, where each element $\mathbf{^{F}IF_k^{V}}$ (accounts for the total value of insurance & freight for imports of goods by Vietnam's final domestic demand sector *k* from partner country, Thailand), $\mathbf{-IF^{\cdot}}$:

total value of insurance & freight for the bilateral (Thailand-Vietnam) imports of goods, with negative sign, $^{I}\mathbf{M}^{WT}$: row vector, where each element $^{I}m_{j}^{WT}$ (accounts for total value of imports from ROW by Thailand's production sector *j*), $^{I}\mathbf{M}^{WV}$: row vector, where each element $^{I}m_{j}^{WV}$ (accounts for total value of imports from ROW by Vietnam's production sector *j*), $^{F}\mathbf{M}^{WT}$: row vector, where each element $^{F}m_{k}^{WT}$ (accounts for total value of imports from ROW by Thailand's final domestic demand sector *k*), $^{F}\mathbf{M}^{WV}$: row vector, where each element $^{F}m_{k}^{WV}$ (accounts for total value of imports from ROW by Vietnam's final domestic demand sector *k*), $-\mathbf{M}^{W\cdot}$: total value of bilateral (Thailand-Vietnam) trade of imports, with negative sign, $^{I}\mathbf{DT}^{T}$: row vector, where each element $^{I}dt_{j}^{T}$ (accounts for customs duties & taxes paid for imports by Thailand's production sector *j*), $^{I}\mathbf{DT}^{V}$: row vector, where each element $^{I}dt_{j}^{V}$ (accounts for customs duties & taxes paid for imports by Vietnam's production sector *j*), $^{F}\mathbf{DT}^{T}$: row vector, where each element $^{I}dt_{k}^{T}$ (accounts for customs duties & taxes paid for imports by Thailand's final domestic demand sector *k*), $^{F}\mathbf{DT}^{V}$: row vector, where each element $^{I}dt_{k}^{V}$ (accounts for customs duties & taxes paid for imports by Vietnam's final domestic demand sector *k*), $-\mathbf{DT}^{\cdot}$: total value of customs duties & taxes paid for bilateral (Thailand-Vietnam) trade of imports with negative sign, $\mathbf{V}^{T}$: p x n matrix, where each element v_{pj}^{T} (accounts for primary input *p* generated by Thailand's production sector *j*), $\mathbf{V}^{V}$: p x n matrix, where each element v_{pj}^{V} (accounts for primary input *p* generated by Vietnam's production sector *j*), $\mathbf{V}^{\cdot}$: column vector of total primary inputs generated by the bilateral (Thailand-Vietnam) economy, $\mathbf{X}^{T\prime}$: row vector, where each element, $x_{j}^{T\cdot}$ (accounts for the gross input of Thailand's production sector *j*), $\mathbf{X}^{V\prime}$: row vector, where each element, $x_{j}^{V\prime}$ (accounts for the gross input of Thailand's production sector *j*).

The outlined IRIO model is of the non-competitive, open and static variety. It is non-competitive because it makes an explicit distinction between nationally-produced and imported products. Such a distinction provides a better reflection of the use of domestic production technology and inputs in the production of output in each country. The "openness" of the model is derived from the fact that economic activities are split into the intermediate and final demand categories. The transactions in the former category can be explained by the model, while the latter category contains exogenous transactions which must be initially known or given. The static nature of the model is a consequence of the absence of a time dimension from it, i.e. the IO transactions relate to the selected fixed period, which, in this case, is calendar year 2000.

BALANCE and STRUCTURAL EQUATIONS

A system of IRIO tables is balanced, implying that the supply and demand sides are equal. Using Figure 1, this equality can be translated into the following accounting identities:

(i) $\mathbf{X}^{T} = \mathbf{X}^{T'}$, (ie, column vector of gross outputs of Thailand's products is equal to row vector of gross inputs of Thailand's production sectors);

$\mathbf{X}^{V} = \mathbf{X}^{V'}$, (ie, column vector of gross outputs of Vietnam's products is equal to row vector of gross inputs of Thailand's production sectors).

(ii) $\sum \mathbf{V}^{\cdot} = \sum \left[\mathbf{F}^{\cdot T} + \mathbf{F}^{\cdot V} + \Sigma \mathbf{E}^{W} - \Sigma \mathbf{M}^{W}\right]$, (ie, sum of the two economies' value added or gross domestic product (GDP) is equal to the two economies' total final demands).

Figure 1 can also be used to form the following balancing equations in matrix form:

$$\mathbf{X}^{T} = \mathbf{X}^{TT}\mathbf{i} + \mathbf{X}^{TV}\mathbf{i} + \mathbf{F}^{TT} + \mathbf{F}^{TV} + \mathbf{E}^{TW} \qquad (1)$$

$$\mathbf{X}^{V} = \mathbf{X}^{VT}\mathbf{i} + \mathbf{X}^{VV}\mathbf{i} + \mathbf{F}^{VT} + \mathbf{F}^{VV} + \mathbf{E}^{VW} \qquad (2)$$

In both equations, $\mathbf{i}$ represents a column vector of appropriate ones. The first term on the right hand side of equation (1) represents intermediate consumption of products of Thailand by its (Thailand's) own production sectors, the second term denotes the trade flows of products of Thailand to Vietnam for intermediate consumption, the third and fourth terms represent the sales of the output of Thailand to its own final domestic demand and Vietnam respectively, while the last term represents the exports of Thailand to the ROW, i.e. all areas outside the bi-nation's territorial limits. An analogous explanation applies to equation (2).

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:

$$\mathbf{A}^{TT} = \mathbf{X}^{TT}\left(\hat{\mathbf{X}}^{T}\right)^{-1} \tag{3}$$

$$\mathbf{A}^{TV} = \mathbf{X}^{TV}\left(\hat{\mathbf{X}}^{V}\right)^{-1} \tag{4}$$

$$\mathbf{A}^{VT} = \mathbf{X}^{VT}\left(\hat{\mathbf{X}}^{T}\right)^{-1} \tag{5}$$

$$\mathbf{A}^{VV} = \mathbf{X}^{VV}\left(\hat{\mathbf{X}}^{V}\right)^{-1} \tag{6}$$

Equations (3) and (6) represent the matrices of intra-national direct input coefficients, while equations (4) and (5) stand for the matrices of inter-national trade coefficients. Substituting these structural equations into equations (1) and (2), we have:

$$\mathbf{X}^{T} = \mathbf{A}^{TT}\mathbf{X}^{T} + \mathbf{A}^{TV}\mathbf{X}^{V} + \mathbf{F}^{TT} + \mathbf{F}^{TV} + \mathbf{E}^{TW} \tag{7}$$

$$\mathbf{X}^{V} = \mathbf{A}^{VT}\mathbf{X}^{T} + \mathbf{A}^{VV}\mathbf{X}^{V} + \mathbf{F}^{VT} + \mathbf{F}^{VV} + \mathbf{E}^{VW} \tag{8}$$

Combining equations (7) and (8), we have:

$$\begin{bmatrix}\mathbf{X}^{T}\\ \mathbf{X}^{V}\end{bmatrix} = \begin{bmatrix}\mathbf{A}^{TT} & \mathbf{A}^{TV}\\ \mathbf{A}^{VT} & \mathbf{A}^{VV}\end{bmatrix}\begin{bmatrix}\mathbf{X}^{T}\\ \mathbf{X}^{V}\end{bmatrix} + \begin{bmatrix}\mathbf{Y}^{T}\\ \mathbf{Y}^{V}\end{bmatrix} \tag{9}$$

where $\mathbf{Y}^{T} = \mathbf{F}^{TT} + \mathbf{F}^{TV} + \mathbf{E}^{TW}$ and $\mathbf{Y}^{V} = \mathbf{F}^{VT} + \mathbf{F}^{VV} + \mathbf{E}^{VW}$.

Simplifying equation (9), we have:

$$\begin{bmatrix}\mathbf{X}^{T}\\ \mathbf{X}^{V}\end{bmatrix} = \left[\begin{pmatrix}\mathbf{I} & \mathbf{0}\\ \mathbf{0} & \mathbf{I}\end{pmatrix} - \begin{pmatrix}\mathbf{A}^{TT} & \mathbf{A}^{TV}\\ \mathbf{A}^{VT} & \mathbf{A}^{VV}\end{pmatrix}\right]^{-1}\begin{bmatrix}\mathbf{Y}^{T}\\ \mathbf{Y}^{V}\end{bmatrix} = \begin{bmatrix}\mathbf{L}^{TT} & \mathbf{L}^{TV}\\ \mathbf{L}^{VT} & \mathbf{L}^{VV}\end{bmatrix}\begin{bmatrix}\mathbf{Y}^{T}\\ \mathbf{Y}^{V}\end{bmatrix} \tag{10}$$

Equation (10) can be further simplified and shown its generalized form as:

$$\mathbf{X} = \mathbf{L}\mathbf{Y} \tag{11}$$

where $\mathbf{X}$ is the matrix of national outputs, $\begin{bmatrix}\mathbf{X}^{T}\\ \mathbf{X}^{V}\end{bmatrix}$; $\mathbf{Y}$ is the matrix of national final demands, $\begin{bmatrix}\mathbf{Y}^{T}\\ \mathbf{Y}^{V}\end{bmatrix}$; and $\mathbf{L}$ is the inter-national Leontief inverse matrix, $\begin{bmatrix}\mathbf{L}^{TT} & \mathbf{L}^{TV}\\ \mathbf{L}^{VT} & \mathbf{L}^{VV}\end{bmatrix}$.

The Leontief inverse matrix, $\mathbf{L}$, is a table of multipliers that links production, $\mathbf{X}$, and final demand, $\mathbf{Y}$. In this case study, it shows the total (direct plus indirect) outputs in both Thailand and Vietnam that are needed to sustain unit changes in their respective final demands. The inverse matrix is the most important table needed in inter-national input-output analysis as it unravels the inter-national, inter-industrial dependencies brought about by the repercussive effects of changes in final demands.

In order to be able to measure the spillover and feedback effects due to inter-regional (national) trade, Round (2001) decomposed the Leontief inverse, thus rewriting equation (10) into the following form:

$$\begin{bmatrix} \mathbf{X}^{\mathbf{T}} \\ \mathbf{X}^{\mathbf{V}} \end{bmatrix} = \begin{bmatrix} \mathbf{F}^{\mathbf{T}} & 0 \\ 0 & \mathbf{F}^{\mathbf{V}} \end{bmatrix} \begin{bmatrix} \mathbf{I} & \mathbf{S}^{\mathbf{TV}} \\ \mathbf{S}^{\mathbf{VT}} & \mathbf{I} \end{bmatrix} \begin{bmatrix} \mathbf{M}^{\mathbf{T}} & 0 \\ 0 & \mathbf{M}^{\mathbf{V}} \end{bmatrix} \begin{bmatrix} \mathbf{Y}^{\mathbf{T}} \\ \mathbf{Y}^{\mathbf{V}} \end{bmatrix} \tag{12}$$

where: $\mathbf{M}^{\mathbf{T}} = \left(\mathbf{I} - \mathbf{A}^{\mathbf{TT}}\right)^{-1}$ $\mathbf{S}^{\mathbf{TV}} = \mathbf{M}^{\mathbf{T}}\mathbf{A}^{\mathbf{TV}}$ $\mathbf{F}^{\mathbf{T}} = \left(\mathbf{I} - \mathbf{S}^{\mathbf{TV}}\mathbf{S}^{\mathbf{VT}}\right)^{-1}$

$\mathbf{M}^{\mathbf{V}} = \left(\mathbf{I} - \mathbf{A}^{\mathbf{VV}}\right)^{-1}$ $\mathbf{S}^{\mathbf{VT}} = \mathbf{M}^{\mathbf{V}}\mathbf{A}^{\mathbf{VT}}$ $\mathbf{F}^{\mathbf{V}} = \left(\mathbf{I} - \mathbf{S}^{\mathbf{VT}}\mathbf{S}^{\mathbf{TV}}\right)^{-1}$

M accounts for the intra-regional linkages, while S and F show the inter-regional spillover and feedback effects, respectively.

IV. 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 the IRIO model as described in Section II. As an initial attempt, the chosen period of reference was calendar year 2000 because national IO tables for the two countries under study already exist. More importantly, reference year data on bilateral (foreign) trade, albeit limited, have also been made available.

Specifically, the empirical investigation was done in accordance with the following general work sequence:

STEP 1. RE-CONSTRUCTION OF THE NATIONAL IO TABLES OF THE COMPETITIVE TYPE

A. Sector Reclassification

For the general purpose of this study, the basic IO tables (i.e., Thailand's 76-sector table[1] and Vietnam's 112-sector table) were first reduced in size,

[1] Sourced from IDE-JETRO's Asian International IO Tables as aggregated from Thailand's 180-sector most detailed table.

following a specially-designed common sector classification scheme as shown in Annex A. Two symmetric (square) IO tables in 35-sector and 14-sector dimensions were then formed, both of the competitive-import type wherein cell elements account for the inter-sectoral flows of goods and services, whether domestically produced and/or imported. For comparability, the tables are uniformly valued in US Dollars at current producers' prices.

B. Disaggregation of the Foreign Trade Vectors

The collapsed IO tables in Step 1.A show the foreign trade vectors as total trade transactions with the Rest of the World (ROW), which, in this case, includes the bilateral countries under study. However, in order to suit to the data needs of the configured IRIO table (Fig. 1), the column vectors of exports and imports need further deconsolidation into 2 column sub-vectors. That is, Thailand's export column has to be subdivided into 2 sub-columns; a sub-column for export to Vietnam and another for export to ROW, and vice versa. 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.

Annex Figure A shows the configuration of the competitive type of IO table.

STEP 2. CONVERSION FROM COMPETITIVE TO NON-COMPETITIVE

In contrast to the competitive-import type as defined above, the non-competitive-import type of IO table treats separately the imported from the locally-produced commodities by constructing satellite tables on import transactions. Since IO analysis primarily deals with an assessment of the interwoven structure of interdependencies between sectors in the productive system, the non-competitive type of IO table is thus considered to be the appropriate database in IO analysis as it excludes the external (trade) transactions.

The non-competitive tables are derived by subtracting the import tables, as estimated in Step 2A, from the reconstructed competitive tables, and putting them as separate sub-matrices in the IO accounts. The aggregates in both types of IO tables are thus equal.

A. Estimation of International Trade Flows

In the absence of direct information on the import contents of intermediate and final demand transactions specifically on Thailand's & Vietnam's bilateral trade, the estimation of international trade flows was done indirectly by using calculated bilateral trade coefficients. Two satellite import tables are

derived; one table for imports from (bilateral) partner country and the other for imports from the ROW. The tables for Thailand's imports from Vietnam, $\mathbf{M}^{VT}$, and from the ROW, $\mathbf{M}^{WT}$, are calculated as:

$$\mathbf{M}^{VT} = \mathbf{X}^{\cdot T}\left(\hat{\mathbf{TC}}^{VT}\right) \tag{13}$$

where: $\mathbf{X}^{\cdot T}$ is Thailand's competitive IO table; $\hat{\mathbf{TC}}^{VT}$ is a diagonal matrix of interregional trade coefficients, $tc_{i.}^{VT} = \frac{m_{i.}^{VT}}{tdd_i^T}$, where $m_{i.}^{VT}$ is Thailand's import of product *i* from Vietnam; and tdd_i^T is the total domestic demand of product *i* in Thailand, which is equal to total supply (= output + imports) less exports.

$$\mathbf{M}^{WT} = \mathbf{X}^{\cdot T}\left(\hat{\mathbf{TC}}^{WT}\right) \tag{14}$$

where $\hat{\mathbf{TC}}^{WT}$ is a diagonal matrix of interregional trade coefficients, $tc_{i.}^{WT} = \frac{m_{i.}^{WT}}{tdd_i^T}$, where $m_{i.}^{WT}$ is Thailand's import of product *i* from ROW. Similarly, the tables of Vietnam's imports from Thailand, $\mathbf{M}^{TV}$, and from the ROW, $\mathbf{M}^{WV}$, are calculated as:

$$\mathbf{M}^{TV} = \mathbf{X}^{\cdot V}\left(\hat{\mathbf{TC}}^{TV}\right) \tag{15}$$

where $\mathbf{X}^{\cdot V}$ is Vietnam's competitive IO table; $\hat{\mathbf{TC}}^{TV}$ is a diagonal matrix of interregional trade coefficients, $\mathbf{tc}_{i.}^{TV} = \frac{\mathbf{m}_{i.}^{TV}}{\mathbf{tdd}_i^V}$, where $\mathbf{m}_{i.}^{TV}$ is Vietnam's import of product *i* from Thailand; $\mathbf{tdd}_i^V$ is the total domestic demand of product *i* in Vietnam.

$$\mathbf{M}^{WV} = \mathbf{X}^{\cdot V}\left(\hat{\mathbf{TC}}^{WV}\right) \tag{16}$$

where $\hat{\mathbf{TC}}^{WV}$ is a diagonal matrix of interregional trade coefficients, $\mathbf{tc}_{i.}^{WV} = \frac{\mathbf{m}_{i.}^{WV}}{\mathbf{tdd}_i^V}$, where $\mathbf{m}_{i.}^{WV}$ is Vietnam's import of product *i* from ROW.

To summarize, four (4) satellite tables on C.I.F. values of import transactions were generated in this case study, as follows:

1) $\mathbf{M}^{VT}$: Thailand's direct imports of intermediate and final demand commodities from Vietnam;

2) $\mathbf{M}^{WT}$: Thailand's direct imports of intermediate and final demand commodities from the ROW;

3) $\mathbf{M}^{TV}$: Vietnam's direct imports of intermediate and final demand commodities from Thailand;

4) $\mathbf{M}^{WV}$: Vietnam's direct imports of intermediate and final demand commodities from the ROW.

Moreover, supporting tables on import duties and taxes (DT) were also calculated for each of the above tables, given the DT control totals as recorded in the competitive tables. Annex Figure 2 shows the non-competitive type of IO table.

STEP 3. DEVELOPING THE INTEGRATED BILATERAL IRIO TABLE

By combining the national IO tables of the non-competitive type into one tabular lay-out as earlier shown in Fig. 1, the bilateral IO table for Thailand and Vietnam is then formed. Adjustments, however, were made of the import matrices by converting its CIF (Cost, Insurance & Freight) values into producers' price values. The adjustment mainly consists of separating estimated IF (insurance and freight) from each CIF entry by using IF rates derived from IDE-JETRO Asian IO table for 2000 in the case of Thailand. The same IF rates were also used in estimating IF values in the case of Vietnam's CIF imports from Thailand.

For the purpose of this Study ~~Report~~, the resulting IRIO table in 3x3-sector aggregation is appended as Annex Table 1. Also appended are the calculated matrices of direct input coefficients and Leontief inverse (Annex Tables 1A & 1B).

The basic 35- and 14-sector tables could be made available upon request.

V. MAIN RESULTS and APPLICATIONS

This section describes and explains the key results and applications of the study. A comparison of the economies of both countries is made first, before the findings of applications such as multiplier, linkage and impact analyses as well as spillover and feedback

effects are presented and analyzed. For the purpose of this paper, the results are presented based on the IO tables for 14 production sectors, which are further aggregated into the three (3) major sectors.

A. COMPARATIVE ANALYSIS OF ECONOMIC STRUCTURES

This sub-section compares and analyzes the economies of both countries. The supply and demand situation, sources of intermediate inputs, self-sufficiency rates as well as structure of output, GDP and demand for year 2000 are described and explained.

Supply and Demand

In 2000, the total combined volume of economic activities in both Thailand and Vietnam amounted to US$463.6 billion, with Thailand's economy accounting for approximately four-fifths (81.4%) of total supply. The growing economy of Vietnam accounted for the residual one-fifth (18.6%) or US$86.1 billion, expressed in current producers' prices.

In Thailand, domestic production shared 79.7% of total supply, slightly higher than Vietnam's 77.8%. Thailand's economy is therefore less dependent on imports than Vietnam, with imports comprising 20.3% of its total supply, against Vietnam's 22.2% import share.

From the demand side, Table 1A shows that, compared to Vietnam, domestic demand in Thailand accounted for a lower proportion of its total demand. It can be observed that, while Thailand's intermediate demand share (45.3% of total demand) is relatively higher than Vietnam's (43.0%), the proportion of Vietnam's final domestic demand (37.2%) is

Table 2.Overview of Supply and Demand situation: Thailand vs Vietnam, 2000

ITEM	THAILAND		VIETNAM		Bilateral TOTAL	
	US$Mil	%	US$Mil	%	US$Mil	%
TOTAL SUPPLY	**377,412 81.4%**	**100.0**	**86,146 18.6%**	**100.0**	**463,557 100.0%**	**100.0**
A) Production	300,922	79.7	66,998	77.8	367,920	79.4
B) Imports	76,490	20.3	19,147	22.2	95,637	20.6
TOTAL DEMAND	**377,412**	**100.0**	**86,146**	**100.0**	**463,557**	**100.0**
A) Domestic Demand	296,820	78.6	69,055	80.2	366,034	79.0
1) Intermediate	170,801	45.3	37,021	43.0	207,933	56.8
2) Final	126,019	33.4	32,034	37.2	158,142	43.2
a) Consumption	93,945	24.9	22,745	26.4	116,836	31.9
b) Investment	32,074	8.5	9,289	10.8	41,417	11.3
B) Exports	80,592	21.4	17,090	19.8	97,723	21.1

comparatively much higher than Thailand's (33.4%). It appears that, in both final demand components (i.e., consumption and investment), Vietnam's economy exhibited higher shares than Thailand's.

Output Structures

Both countries appear to have different patterns of production. Table 3 shows that, in 2000, a large share of economic activities in Thailand was concentrated in the services sector (37.5% of its total output) as against only 27.8% in Vietnam. On the other hand, output in the agriculture, fishery & forestry sector in Vietnam contributed a much higher share (16.5%) than Thailand's share (5.2%), boosted by Vietnam's crops, livestock & poultry sub-sector which exhibited a high 12.9% share against a mere 4.0% share for Thailand's.

In the industry sector, both countries appeared to be at par in terms of relative shares. In the manufacturing sub-sector, Thailand's production is more concentrated in the manufacture of industrial materials and capital goods, while Vietnam's manufacturing is concentrated in the food, beverage & tobacco sub-sector. In 2000, a little less than one-tenth (9.2%) of Vietnam's total gross output was contributed by its construction sub-sector, much higher than Thailand's 3.5% share, thus boosting Vietnam's higher investment rate relative to Thailand's, as shown in Table 2 (Supply & Demand Situations).

Table 3.Gross Output by sector: Year 2000 (at Producer's price)

SECTOR DESCRIPTION		THAILAND		VIETNAM		Bilateral TOTAL	
		US$M	%	US$M	%	US$M	%
ALL SECTORS		300,922	100.0	66,998	100.0	367,920	100.0
I	AGRICULTURE, FISHERY & FORESTRY	15,583	5.2	11,044	16.5	26,627	7.2
1	Crops, livestock & poulty	12,169	4.0	8,659	12.9	20,827	5.7
2	Logs & forest products	170	0.1	541	0.8	711	0.2
3	Fishery products	3,244	1.1	1,845	2.8	5,089	1.4
II	INDUSTRY	172,463	57.3	37,316	55.7	209,779	57.0
4	Minerals, metallic & non-metallic	3,874	1.3	4,195	6.3	8,069	2.2
5	Food, beverage & tobacco products	27,598	9.2	9,569	14.3	37,167	10.1
6	Other consumer goods	37,392	12.4	7,593	11.3	44,985	12.2
7	Industrial materials	38,269	12.7	5,349	8.0	43,618	11.9
8	Capital goods	44,446	14.8	3,042	4.5	47,488	12.9
9	Electricity, gas, steam and water	10,260	3.4	1,375	2.1	11,635	3.2
10	Construction	10,624	3.5	6,193	9.2	16,817	4.6
III	SERVICES	112,875	37.5	18,639	27.8	131,514	35.7
11	Wholesale & retail trade services	36,766	12.2	5,685	8.5	42,450	11.5
12	Transportation services	15,960	5.3	1,276	1.9	17,236	4.7
13	Post & telecommunication	3,421	1.1	775	1.2	4,196	1.1
14	All other services	56,729	18.9	10,902	16.3	67,631	18.4

Input Structures

At the aggregate level, the input or production cost structure in both countries appears to be rather similar. Table 4 shows that, in Thailand's productive economy, 56.8 cents for every dollar of production cost or gross output in 2000 went to the purchase of intermediate inputs, with the remainder going to primary input payments or what is value added to the economy. In Vietnam, the cost of intermediate inputs was slightly lower at 55.3

cents per dollar, hence its value added generated (44.7 cents) was higher than Thailand's (43.2 cents).

An assessment of the various industries shows that, in both countries, the light manufacturing industries such as sub-sectors 5 (food, beverage & tobacco) and 6 (other consumer goods) tend to source a rather high proportion of their intermediate inputs domestically. In contrast, the heavy manufacturing industries such as sectors 7 (industrial materials) and 8 (capital goods) in both countries are found to be highly dependent on imports, most specifically from the ROW.

In the transportation and communications sub-sectors, Table 5 shows contrasting patterns of input usage in the two countries under study. In Thailand, the cost of operation of transportation and communication services relies heavily on domestically-sourced inputs rather than on imports.

Table 4.Sectoral Cost of Production of Input:Thailand vs Vietnam, 2000
（Expressed as percentage to Total Inputs）

PRODUCTION SECTOR		THAILAND		VIETNAM	
		TII	TPI	TII	TPI
ALL SECTORS		0.568	0.432	0.553	0.447
I	AGRICULTURE, FORESTRY & FISHERY	0.380	0.620	0.328	0.672
1	Crops, livestock & poulty	0.370	0.630	0.312	0.688
2	Logs & forest products	0.163	0.837	0.227	0.773
3	Fishery products	0.427	0.573	0.429	0.571
II	INDUSTRY	0.694	0.306	0.693	0.307
4	Minerals, metallic & non-metallic	0.299	0.701	0.283	0.717
5	Food, beverage & tobacco products	0.697	0.303	0.793	0.207
6	Other consumer goods	0.668	0.332	0.794	0.206
7	Industrial materials	0.698	0.302	0.723	0.277
8	Capital goods	0.794	0.206	0.743	0.257
9	Electricity, gas, steam and water	0.490	0.510	0.294	0.706
10	Construction	0.688	0.312	0.730	0.270
III	SERVICES	0.400	0.600	0.405	0.595
11	Wholesale & retail trade services	0.185	0.815	0.457	0.543
12	Transportation services	0.655	0.345	0.481	0.519
13	Post & telecommunication	0.287	0.713	0.274	0.726
14	All other services	0.475	0.525	0.378	0.622

TII : Total Intermediate Input　　TPI : Total Primary Input

In contrast, these sectors in Vietnam exhibited significantly high shares of imported input requirements, the fact that, in 2000, Vietnam was not yet a producer of fuel oils as the primary input in the operation of transport services. Also, Vietnam's communications industry in 2000 was still in its developmental stage, hence its continued operation relied more on the ROW for the supply of intermediate products and services.

Table 5.Sectoral Consumption of Intermediate Input by Source: Thailand vs Vietnam, 2000 (As % to Total Intermediate Input)

PRODUCTION SECTOR		THAILAND				VIETNAM			
		Domestic	Imported			Domestic	Imported		
			Total	from VIE	from ROW		Total	from THA	from ROW
ALL SECTORS		68.3	31.7	0.2	31.5	63.6	36.4	2.2	34.2
I	AGRICULTURE, FORESTRY & FISHERY	85.6	14.4	0.4	14.1	64.0	36.0	1.7	34.3
1	Crops, livestock & poultry	83.3	16.7	0.4	16.3	67.0	33.0	1.5	31.5
2	Logs & forest products	99.3	0.7	0.0	0.7	63.6	36.4	0.7	35.7
3	Fishery products	92.7	7.3	2.9	4.4	54.2	45.8	38.2	7.7
II	INDUSTRY	58.0	42.0	0.2	41.8	64.4	35.6	1.9	33.6
4	Minerals, metallic & non-metallic	97.8	2.2	0.0	2.2	74.6	25.4	2.9	22.4
5	Food, beverage & tobacco products	85.2	14.8	0.2	14.7	87.3	12.7	0.3	12.3
6	Other consumer goods	67.7	32.3	0.1	32.1	55.6	44.4	1.6	42.8
7	Industrial materials	46.5	53.5	0.0	53.5	54.1	45.9	2.9	43.1
8	Capital goods	34.8	65.2	0.3	65.0	44.0	56.0	3.1	52.9
9	Electricity, gas, steam and water	95.8	4.2	0.0	4.2	44.2	55.8	36.1	19.7
10	Construction	75.8	24.2	0.0	24.2	56.0	44.0	0.0	44.0
III	SERVICES	93.4	6.6	0.1	6.5	60.7	39.3	3.2	36.1
11	Wholesale & retail trade services	95.2	4.8	0.2	4.6	62.2	37.8	1.7	36.1
12	Transportation services	96.5	3.5	0.0	3.4	49.8	50.2	6.2	44.0
13	Post & telecommunication	99.7	0.3	0.0	0.3	38.9	61.1	8.0	53.0
14	All other services	91.5	8.5	0.1	8.5	62.5	37.5	4.7	32.8

Gross Domestic Product (GDP)

Table 6 presents a comparative structure of GDP for both countries in year 2000. Expressed in current 2000 prices, Thailand's GDP of US$130.1 billion, as measured in the IO table as total primary inputs (TPI), is observed to be more than four (4) times larger than Vietnam's. With Thailand's population of 62.35 million in 2000, its per capita GDP was estimated to reach US$2,087, more than five (5) times higher than Vietnam's calculated per capita GDP of US$386, given its 2000 population of 77.64 million in 2000.

A sectoral breakdown of GVA generated in 2000 shows that, in Thailand, the top contributors are the services sub-sectors of wholesale & retail trade (11) and all other services (14), accounting for 23.0% and 22.9% shares, respectively. In Vietnam, the top contributor is the all other services sub-sector (14) with 22.6% share, followed by the crops, livestock & poultry sub-sector with 19.9% share. As expected, contribution by the manufacturing sectors of Thailand to GDP appeared to be relatively larger than their counterparts in Vietnam.

Table 6.Primary Input (=Value Added) Structures of Production sectors by Component: Thailand vs Vietnam, 2000 (Expressed as Ratios to Total Input)

		THAILAND					VIETNAM				
		TPI	VV01	VV02	VV03	VV04	TPI	VV01	VV02	VV03	VV04
ALL SECTORS		0.432	0.133	0.206	0.061	0.032	0.447	0.255	0.100	0.044	0.048
I	AGRICULTURE, FORESTRY & FISHERY	0.620	0.160	0.416	0.044	0.001	0.672	0.511	0.070	0.040	0.051
01	Crops, livestock & poulty	0.630	0.166	0.429	0.034	0.001	0.688	0.550	0.050	0.040	0.047
02	Logs & forest products	0.837	0.290	0.501	0.026	0.020	0.773	0.398	0.171	0.034	0.170
03	Fishery products	0.573	0.131	0.360	0.082	0.000	0.571	0.359	0.132	0.043	0.037
II	INDUSTRY	0.306	0.086	0.138	0.050	0.032	0.307	0.129	0.096	0.039	0.043
04	Minerals, metallic & non-metallic	0.701	0.170	0.314	0.124	0.092	0.717	0.287	0.288	0.101	0.041
05	Food, beverage & tobacco products	0.303	0.074	0.142	0.027	0.061	0.207	0.070	0.051	0.018	0.068
06	Other consumer goods	0.332	0.105	0.172	0.045	0.011	0.206	0.081	0.056	0.033	0.037
07	Industrial materials	0.302	0.072	0.134	0.050	0.046	0.277	0.124	0.072	0.048	0.033
08	Capital goods	0.206	0.058	0.092	0.040	0.016	0.257	0.135	0.064	0.030	0.028
09	Electricity, gas, steam and water	0.510	0.178	0.156	0.138	0.038	0.706	0.343	0.294	0.022	0.048
10	Construction	0.312	0.103	0.132	0.060	0.018	0.270	0.126	0.078	0.036	0.030
III	SERVICES	0.600	0.202	0.282	0.079	0.036	0.595	0.354	0.127	0.058	0.056
11	Wholesale & retail trade services	0.815	0.133	0.552	0.075	0.055	0.543	0.271	0.160	0.039	0.073
12	Transportation services	0.345	0.134	0.135	0.070	0.005	0.519	0.262	0.125	0.083	0.050
13	Post & telecommunication	0.713	0.218	0.318	0.161	0.016	0.726	0.318	0.185	0.172	0.051
14	All other services	0.525	0.264	0.147	0.080	0.034	0.622	0.410	0.106	0.056	0.049

TPI: Total Primary Inputs (= gross value added) VV02: Operating Surplus VV04: Indirrect taxes less subsidies
VV01: Compensation of employees VV03: Depreciation

By component of GDP, Table 6 suggests that, on the overall, Vietnam's productive economy was more labor-intensive than Thailand's. In 2000, more than half (56.9%) of Vietnam's total primary inputs went to labor payments as against 30.8% by Thailand's. As a consequence, Vietnam's operating surplus (gross of depreciation) generated accounted for only 32.3% of its total GDP, a little less than half of Thailand's GOS share of 61.8%. *One interesting finding is that Vietnam is imposing more taxes to producers than Thailand, as evidenced by Vietnam's NIT share (10.8%), significantly higher than Thailand's 7.4% NIT share.*

Demand Structures

Table 7 shows the distribution of the total supply of goods and services by product group, by type of demand. It can be observed that, at the aggregate level, slight differences exist in their patterns of demand. In Thailand's economy, 45.3% of its total supply amounting to US$377.4 billion in 2000 was consumed by the intermediate sectors in production, slightly higher than Vietnam's 43.0% share. On the other hand, the final domestic demand sectors (final consumption and capital formation) of Vietnam used more of its total supply (37.2%) compared with Thailand's 33.4%. Thailand's proportion of deliveries of products for exports was found to be relatively higher at 21.4% against Vietnam's 19.8%.
However, at the product group level, we can observe significant differences in the structure of demand. For instance, four-fifths (80.5%) of Thailand's supply of agriculture and forestry products was absorbed by intermediate demand as inputs for further processing.

Table 7. Distribution of Total Supply by Product, By the Type of Demand: Thailand vs Vietnam, 2000

PRODUCT GROUP		THAILAND				VIETNAM			
		Total Supply US$million	TID %	TDFD %	TXP %	Total Supply US$million	TID %	TDFD %	TXP %
ALL PRODUCTS		377,412	45.3	33.4	21.4	86,146	43.0	37.2	19.8
I	AGRICULTURE, FORESTRY & FISHERY	17,290	80.5	15.4	4.1	11,325	52.6	32.6	14.8
1	Crops, livestock & poulty	13,536	80.3	15.0	4.7	8,862	53.2	32.2	14.6
2	Logs & forest products	431	101.2	-10.4	9.1	613	77.3	15.7	7.0
3	Fishery products	3,324	78.2	20.7	1.1	1,850	41.6	40.5	17.9
II	INDUSTRY	239,020	46.9	26.0	27.1	51,997	43.0	35.3	21.7
4	Minerals, metallic & non-metallic	10,854	99.1	-3.4	4.3	4,360	16.1	1.2	82.7
5	Food, beverage & tobacco products	30,906	31.7	37.9	30.4	10,182	17.9	59.3	22.9
6	Other consumer goods	45,681	36.9	32.6	30.4	10,856	46.0	18.5	35.5
7	Industrial materials	57,053	65.6	14.1	20.3	11,585	85.6	10.7	3.8
8	Capital goods	73,350	39.7	20.7	39.5	7,408	52.1	33.7	14.2
9	Electricity, gas, steam and water	10,547	75.5	21.8	2.7	1,414	74.5	25.5	0.0
10	Construction	10,629	1.7	98.2	0.1	6,193	0.0	100.0	0.0
III	SERVICES	121,101	37.0	50.5	12.6	22,823	38.2	43.6	18.1
11	Wholesale & retail trade services	39,778	41.8	46.8	11.3	7,936	52.5	27.4	20.2
12	Transportation services	17,393	37.6	34.8	27.6	1,769	31.1	31.7	37.2
13	Post & telecommunication	3,908	53.4	33.9	12.8	798	65.2	14.3	20.5
14	All other services	60,022	32.5	58.5	9.0	12,320	28.3	57.7	13.9
	TID: Total Intermediate Demand		TDFD: Total Domestic Final Demand			TXP: Total Exports			

In contrast, a large proportion of Vietnam's supply of agriculture and forestry products was delivered to meet final demand needs, whether for final domestic demand (32.6%) or for exports (14.8%), thus leaving a little over half (52.6%) of its total supply for intermediate use.

In the industry and services groups, the patterns of demand structure in both countries appeared to be quite similar, although, at the sub-sector level, significant differences in demand trends are observable.

Self-Sufficiency Rates

The self-sufficiency rate is defined as the ratio of total production to total domestic demand, so that in each region, we have:

$$SSR_i^R = \frac{X_i^R}{TDD_i^R} \qquad (13)$$

where: SSR_i^R is the self-sufficiency rate of product *i* in region *R*;

X_i^R is the gross output of product *i* in region *R*; and

TDD_i^R is the total domestic demand (i.e., intermediate plus final demand less exports) for

product *i* in region *R*, *R* = Thailand, Vietnam.

A sector with SSR ≥ 1 means that its output is sufficient to sustain its domestic demand. On the other hand, a sector with SSR < 1 suggests that imports are needed to meet that sector's total domestic demand.

Table 8 presents the self-sufficiency rates by sector that were calculated from the intra-national IO tables of the competitive type. On the whole, it appears that Thailand's economy is self-sufficient, as its weighted average SSR is > unity (1.014), while Vietnam's economy in 2000 was quite dependent on imports to meet its domestic needs, hence its overall average SSR is < unity (0.970).

At the 14-sector level of aggregation, Table 5 shows that eight (8) out of the 14-sector groupings in Thailand registered > unity SSRs, led by the food, beverage & tobacco manufacturing group (5) with SSR of 1.28, followed by transportation services (12) and other consumer goods manufacturing (6) with SSRs of 1.27 and 1.18, respectively. Ironically, while Vietnam's overall average SSR is < unity, yet nine (9) out of 14 were found be self-sufficient, one (1) more than Thailand's. This finding is explained by the fact that Vietnam's manufacturing sectors, which account for the main bulk of the country's total demand, relied heavily, more than Thailand's, on importations to sustain their supply requirements, thus resulting in extremely low SSRS, particularly for industrial materials (7) and capital goods (8) sectors.

Table 8. Self-Sufficiency Ratios: Thailand vs Vietnam, 2000
(Output as Ratio to Total Domestic Demand)

	PRODUCT GROUP	THAILAND	VIETNAM
	TOTAL ECONOMY	***1.014***	***0.970***
I	***AGRICULTURE, FORESTRY & FISHERY***	***0.940***	***1.144***
1	**Crops, livestock & poultry**	0.943	1.145
2	Logs & forest products	0.435	0.948
3	Fishery products	0.987	1.215
II	***INDUSTRY***	***0.989***	***0.916***
4	Minerals, metallic & non-metallic	0.373	5.571
5	Food, beverage & tobacco products	1.284	1.218
6	Other consumer goods	1.177	1.084
7	Industrial materials	0.842	0.480
8	Capital goods	1.002	0.479
9	Electricity, gas, steam and water	0.999	0.973
10	Construction	1.001	1.000
III	***SERVICES***	***1.066***	***0.998***
11	Wholesale & retail trade services	1.042	0.898
12	Transportation services	1.267	1.148
13	Post & telecommunication	1.003	1.222
14	All other services	1.039	1.028

NOTE: Total Domestic Demand = Intermediate Demand + Final Demand - Exports

The reason for the extraordinarily high SSR (5.57) for Vietnam's mining sector (4) is because the biggest bulk of its raw output, primarily metallic ores, went to foreign demand, i.e., exports. In contrast, the reason for the extremely low SSR (0.37) for this sector in Thailand is because the country is a heavy importer of crude oil to sustain its petroleum products manufacture. Vietnam was not a producer but an importer of refined petroleum products in 2000, hence no imports of mineral crude oil.

B. INTERREGIONAL ANALYSIS AND APPLICATIONS

This section analyses the economic relationship between the two countries in terms of its bilateral trade. The findings of applications such as multiplier, linkage and impact analyses as well as spillover and feedback effects are also presented and analyzed.

International Trade

A salient feature of the IRIO table is interregional (or international) trade. In our study, international outflows/inflows of products are explicitly recorded as separate sub-matrices. Thus, our IRIO table can be used to determine the extent of Thailand's dependence on Vietnam's products and, vice versa. Given the Leontief's inter-regional inverse, the spillover and feedback effects of international trade on the two economies can then be measured.

Table 9 summarizes, in matrix format, the origin-destination of trade outflows (or exports) and inflows (or imports) of merchandise goods for 2000. The row entries represent a region's (or nation's) outflows of its outputs to its partner region and the exogenous region (the ROW), while the column entries account for a region's inflows from its partner region and ROW. The difference between row and column totals represents the merchandise trade balance.

Table 9. International Merchandise Trade Summary: Thailand vs-Vietnam-ROW, 2000 (Values are in Million USD)

Destination / Origin	THAILAND		VIETNAM		ROW		Total Exports
	Value	%	Value	%	Value	%	
THAILAND			769.8	5.6	64,303.5	83.6	65,073.3
			1.2%		98.8%		100.0%
VIETNAM	336.9	0.5			12,612.1	16.4	12,949.0
	2.6%				97.4%		100.0%
ROW	62,884.6	99.5	13,001.8	94.4			75,886.5
	82.9%		17.1%				100.0%
Total Imports	63,221.5	100.0	13,771.6	100.0	76,915.6	100.0	153,908.8

As can be observed from Table 6A, total international trade in 2000 between Thailand and Vietnam and the exogenous region ROW amounted to US$153.9 billion. This trade volume is equivalent to a mere 1.2% of total world trade of US$12.9 trillion, but within the ASEAN region, its (Thailand and Vietnam) total foreign trade transactions accounted for a significant 20% share of the ASEAN's trade volume of US$811.7 billion in 2000. [2]

The above table shows that approximately half of the two countries' foreign trade transactions were made with the ROW. Thailand had a favorable merchandise trade balance with the ROW, as its exports reached US$64.3 billion, higher than its imports of US$62.9 billion. In contrast, Vietnam exhibited a negative merchandise trade balance with the ROW, with its exports of US$12.6 billion lower than its imports of US$13.0 billion in 2000. *In terms of bilateral trade, Vietnam had a negative trade balance with Thailand, as its exports of US$337 million to Thailand was more than twice lower than its corresponding imports from Thailand of US$770 million.*

By commodity group, Table 10 shows that industrial goods occupy the largest share of bilateral trade transactions, although less intense from the Vietnam side. Thailand's exports of industrial goods to Vietnam accounted for 98.4% of total, relatively much higher than Vietnam's corresponding export ratio of 88.7% as Vietnam's exports of agricultural, fishery & forestry products accounted for a significant 11.3% share as against 1.6% share exported by Thailand to Vietnam.

[2] 2008 International Trade Statistics Yearbook, Volume I – Trade by Country

Table 10. Distribution of International Merchandise Trade by Product: Thailand vs Vietnam, 2000 (in Percent)

PRODUCT		THAILAND				VIETNAM			
		EXPORTS to:		IMPORTS from:		EXPORTS to:		IMPORTS from:	
		VN	ROW	VN	ROW	TL	ROW	TL	ROW
I	AGRICULTURE, FORESTRY & FISHERY	1.6	1.1	13.1	2.2	11.3	12.9	1.6	1.9
1	Crops, livestock & poulty	1.1	1.0	9.0	1.8	7.6	10.1	1.1	1.3
2	Logs & forest products	0.2	0.1	0.0	0.4	0.0	0.3	0.2	0.5
3	Fishery products	0.3	0.1	4.1	0.0	3.7	2.5	0.3	0.0
II	INDUSTRIAL GOODS	98.4	98.9	86.9	97.8	88.7	87.1	98.4	98.1
4	Minerals, metallic & non-metallic	2.1	0.7	20.3	10.4	21.6	28.0	2.2	1.0
5	Food, beverage & tobacco products	2.1	14.6	11.2	4.7	8.2	18.2	2.1	4.1
6	Other consumer goods	14.4	21.5	11.3	11.9	9.0	30.3	15.2	22.4
7	Industrial materials	47.6	17.4	3.1	27.8	2.0	3.4	48.3	41.3
8	Capital goods	32.3	44.7	41.1	43.1	47.9	7.1	30.6	29.3
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	TOTAL VALUE (US $million)	769.8	64,303.5	274.6	62,884.6	336.9	12,612.1	696.4	13,001.8

Output Multipliers

Presented in Table 11 are estimated total (direct and indirect) output multipliers, calculated from the bilateral IRIO table's Leontief inverse. The column sums of the IRIO inverse represent the total outputs that producing sectors have to produce in order to sustain a unit demand of their products. For example, in order to satisfy 1000 units of demand for crops, livestock & poultry products by both Thailand and Vietnam, Thailand's economy needs to produce 1,511 units of output, out of which 1000 units goes to the crops, livestock & poultry sector itself and the residual 511 units to sustain the direct and indirect demand by other sectors in both Thailand's and Vietnam's productive economies.

Ranked in descending order, Table 7 indicates that the extent of interdependencies between the production sectors in Thailand's economy is observed to be relatively more intense than in Vietnam's. Evidently, 9 sectors in Thailand exhibited total output multipliers ranked in the upper half of the 28-sector ladder against 5 in Vietnam. The food, beverage & tobacco sector of Vietnam exhibited the highest output multiplier effect of 2.016, followed by Thailand's transport services (12) and food, beverage & tobacco (05) sectors with output multiplier effects of 1.995 and 1.966, respectively. This finding indicates that these sectors are relatively the heaviest intermediate consumers of domestically-produced outputs, while their dependencies on imported inputs are observed to be relatively low.

The top bottom three, in terms of total output multipliers, all belongs to Vietnam's post & telecommunication (13), electricity, gas, steam & water (09) and logs & forest products (02) with TOMs of 1.16, 1.19 and 1.20, respectively. These sectors are least users of

intermediate inputs, with most of their material purchases coming from the ROW, as can be observed in Table 3B.

Table 11. Total Output Multipliers
(Total Output Requirements Per Unit of Final Demand)

SECTOR		THAILAND		VIETNAM	
		TOM	RANK	TOM	RANK
01	Crops, livestock & poulty	1.511	13	1.318	22
02	Logs & forest products	1.245	25	1.202	26
03	Fishery products	1.651	10	1.353	21
04	Minerals, metallic & non-metallic	1.471	15	1.286	24
05	Food, beverage & tobacco products	1.966	3	2.016	1
06	Other consumer goods	1.730	7	1.707	8
07	Industrial materials	1.504	14	1.619	11
08	Capital goods	1.408	18	1.527	12
09	Electricity, gas, steam and water	1.753	5	1.190	27
10	Construction	1.822	4	1.654	9
11	Wholesale & retail trade services	1.301	23	1.430	17
12	Transportation services	1.995	2	1.375	19
13	Post & telecommunication	1.463	16	1.160	28
14	All other services	1.732	6	1.360	20
	TOM: Total Ouput Multiplier				

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. In essence, there are two types of linkages, namely, backward linkages and forward linkages.

A backward linkage 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 backward linkage 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) as the index of the power of dispersion, μ_j, and is defined mathematically as

$$\mu_j = \frac{\sum_{i=1}^{n} \ell_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \ell_{ij}} \qquad (14)$$

where the ℓ_{ij} is the element of the inter-regional Leontief inverse. The higher the value of μ_j, the stronger is the influence of production sector *j* as a user of intermediate inputs.

A forward linkage 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 forward linkage 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 described by Rasmussen (1957) as the index of sensitivity, μ_i, and is defined mathematically as

$$\mu_i = \frac{\sum_{j=1}^{n} \ell_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \ell_{ij}} \qquad (15)$$

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 estimated inter-regional linkages in our study are presented in Table 12. As can be seen, the estimated values of the backward and forward linkages in both countries appear to be relatively quite low, when compared to linkage effects of more developed economies

Only half of the 14 industries in Thailand and 5 industries in Vietnam had values for backward linkages greater than one in 2000. In the case of forward linkages, 8 industries in Thailand

Table 12. Inter National Backward & Forward Linkage Effects, 2000

SECTOR		THAILAND				VIETNAM			
		Backward Linkage		Forward Linkage		Backward Linkage		Forward Linkage	
		INDEX	RANK	INDEX	RANK	INDEX	RANK	INDEX	RANK
01	Crops, livestock & poultry	0.990	13	1.050	10	0.863	22	1.091	08
02	Logs & forest products	0.815	25	0.680	26	0.787	26	0.753	23
03	Fishery products	1.082	10	0.762	20	0.886	21	0.756	22
04	Minerals, metallic & non-metallic	0.963	15	0.963	15	0.843	24	0.760	21
05	Food, beverage & tobacco products	1.288	03	1.048	12	1.320	01	0.834	18
06	Other consumer goods	1.133	07	1.049	11	1.118	08	1.045	13
07	Industrial materials	0.985	14	1.885	01	1.060	11	1.547	02
08	Capital goods	0.922	18	1.158	06	1.000	12	0.954	16
09	Electricity, gas, steam and water	1.149	05	1.084	09	0.779	27	0.877	17
10	Construction	1.193	04	0.664	27	1.084	09	0.655	28
11	Wholesale & retail trade services	0.852	23	1.264	04	0.936	17	1.135	07
12	Transportation services	1.307	02	0.993	14	0.901	19	0.714	25
13	Post & telecommunication	0.958	16	0.815	19	0.760	28	0.751	24
14	All other services	1.135	06	1.546	03	0.891	20	1.170	05

and 5 in Vietnam had values higher than one. *One likely reason for these rather low values could be the high reliance of both countries on the outside world (ROW) for their supply requirements.*

It is possible to split the industries in question according to their calculated degrees of interdependencies. Industries with linkages greater than or equal to unity are defined as industries with high interdependencies, while those with linkages below unity are considered as industries with low interdependencies. Based on these definitions, Chenery and Clark (1959) classified industries into the following four groups:

GROUP I: HIGH μ_j, HIGH μ_i GROUP II: HIGH μ_j, LOW μ_i

GROUP III: LOW μ_j, HIGH μ_i GROUP IV: LOW μ_j, LOW μ_i

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 μ_i, they are also characterized by large values of μ_j, 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 μ_j 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 industries in our study according to the classification scheme of Chenery and Clark (1959), as shown in Table 13, reveals that more industries in Vietnam belong to Group IV than those in Thailand. On the other hand, more industries in Thailand belong to Group I than those in Vietnam.

Table 13. Grouping of Production Sectors According to Their Total Linkage Effects

		FORWARD LINKAGE	
		HIGH	LOW
BACKWARD LINKAGE	HIGH	GROUP I	GROUP II
		AT05 Food, beverage & tobacco prods	AT03 Fishery products
		AT06 Other consumer goods	AT10 Construction
		AT09 Electricity, gas, steam and water	AT12 Transportation services
		AT14 All other services	AV05 Food, beverage & tobacco prods
		AV06 Other consumer goods	AV08 Capital goods
		AV07 Industrial materials	AV10 Construction
	LOW	GROUP III	GROUP IV
		AT01 Crops, livestock & poulty	AT02 Logs & forest products
		AT07 Industrial materials	AT04 Minerals, metallic & non-metallic
		AT08 Capital goods	AT13 Post & telecommunication
		AT11 Wholesale & retail trade services	AV02 Logs & forest products
		AV01 Crops, livestock & poulty	AV03 Fishery products
		AV11 Wholesale & retail trade services	AV04 Minerals, metallic & non-metallic
		AV14 All other services	AV09 Electricity, gas, steam and water
			AV12 Transportation services
			AV13 Post & telecommunication

In particular, the manufacturing sectors of food, beverage & tobacco (05) and other consumer goods (06) as well as the electricity, gas & water (09) and other services (14) sectors in Thailand and the manufacturing sectors of other consumer goods (06) and industrial materials (07) in Vietnam are classified under this group. This suggests that on the basis of the estimated linkage effects, these industries can be given higher priority in the development of policies to enhance the economies of both countries.

Spillover and Feedback Effects

A single-region 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 interregional 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 Thailand. This will result in an increase in the output of the manufacturing industry in Thailand, which could result in an increase in demand for relevant inputs from suppliers outside the country, say, Vietnam. This new demand for the output of the suppliers in Vietnam will create an increase in their output and, directly and indirectly, the output of other industries in Vietnam. This stimulus of new output in Vietnam due to new output in Thailand is known as the interregional spillover effect. In addition, suppose that the stimulated production in Vietnam includes increased output of industries that use inputs from Thailand in their production process. Thus, the

increased manufacturing production in Thailand leads to increased output of its suppliers in Vietnam, which, in turn, leads to more production in Thailand. This is known as the interregional feedback effect. These interregional effects can be measured within the context of an IRIO table.

This sub-section quantifies the spillover and feedback effects due to interregional trade in products to sustain regional final demands. Table 14 shows that, because of weak inter-regional (national) linkages among and between sectors, the estimated spillover and feedback effects appear to be insignificant.[3]

Table 14. International Spillover & Feedback Effect, 2000

PRODUCTION SECTOR		THAILAND		VIETNAM	
		Spillover	Feedback	Spillover	Feedback
01	Crops, livestock & poulty	0.00367	0.00000	0.00104	0.00001
02	Logs & forest products	0.00035	0.00000	0.00005	0.00000
03	Fishery products	0.00055	0.00000	0.00028	0.00001
04	Minerals, metallic & non-metallic	0.00646	0.00001	0.00145	0.00010
05	Food, beverage & tobacco products	0.00246	0.00000	0.00075	0.00001
06	Other consumer goods	0.01866	0.00002	0.00068	0.00002
07	Industrial materials	0.07510	0.00006	0.00088	0.00003
08	Capital goods	0.03748	0.00006	0.00230	0.00008
09	Electricity, gas, steam and water	0.00893	0.00001	0.00017	0.00001
10	Construction	0.00010	0.00000	0.00000	0.00000
11	Wholesale & retail trade services	0.02130	0.00002	0.00304	0.00013
12	Transportation services	0.00868	0.00001	0.00025	0.00001
13	Post & telecommunication	0.00164	0.00000	0.00010	0.00001
14	All other services	0.02066	0.00002	0.00075	0.00003
OUTPUT WEIGHTED AVERAGE		**0.02515**	**0.00003**	**0.00098**	**0.00003**

Note: 0.00000 denotes value is less than half of unit employed.

Table 14 shows that the average spillover effect of Thailand's productive economy due to its trade transactions with Vietnam is estimated to be a mere US$25 for every US$1000 increase in final demand, while the estimated spillover effect of Vietnam's production sectors as the result of its trade transactions with Thailand is observed to be negligible at US$1 per US$1000 increase in final demand. Spillover effects are seen to be higher for Thailand's manufacturing sectors of industrial materials (07) and capital goods (08) with US$75 and US$37 spillover effects, respectively. Feedback effects in both regions are found to be very negligible. *The results indicate that both countries rely heavily, not on each other's produce, but on the ROW for products used in production and for final consumption.*

[3] These spillover and feedback effects were computed from the matrices S^{TV} and S^{VT}, and F^{T} and F^{V} in equation (12).

C. IMPACT ANALYSIS

Final demand for products has repercussive effects on the economy. In the first round, an increase in demand for a product of a particular sector will require additional output requirement for that sector. Subsequently, the first-order increases in output would require further inputs to generate them. The increased demand therefore translates to an increase in output, which in turn result to increases in income of the sectors involved and so on. These total multiplier effects of final demand for goods and services on economies are best measured through I-O analysis.

Given the I-O table's Leontief inverse, it is possible to quantify the direct as well as the indirect effects of changes in exogenous final demand on such economic variables as output, income, employment and import requirements. This sub-section quantifies the impact of the different components of final demand on these macroeconomic indicators.

Impact on Production

The calculation of total (direct + indirect) outputs required to sustain final demands is carried out using equation (11) in its generalized form, as follows:

$$\mathbf{X} = \mathbf{L}\mathbf{Y} \tag{16}$$

where $\mathbf{X}$ is the matrix of national outputs, $\begin{bmatrix} \mathbf{X}^{T} \\ \mathbf{X}^{V} \end{bmatrix}$; $\mathbf{Y}$ is the matrix of national final demands, $\begin{bmatrix} \mathbf{Y}^{T} \\ \mathbf{Y}^{V} \end{bmatrix}$; and $\mathbf{L}$ is the inter-national Leontief inverse matrix, $\begin{bmatrix} \mathbf{L}^{TT} & \mathbf{L}^{TV} \\ \mathbf{L}^{VT} & \mathbf{L}^{VV} \end{bmatrix}$; superscripts T and V denote bilateral countries, Thailand and Vietnam, respectively.

Table 10 summarizes the impact of final demand on production for the 3 major sectors for 2000. The row entries in the table describe how sectoral output is induced by each type of final demand in both countries. Conversely, the column entries in the table record the breakdown of sectoral output required from both countries to satisfy the needs of each type of final demand in one country. The column sums can be interpreted to be the total output induced by each type of final demand in each country.

It can be observed from Table 15 that, of the combined production of US$367.85 billion in both countries in 2000, 81.5% was induced by Thailand's total final demand, broken down into: 37.9% by final consumption demand, 9.4% by capital formation or investment demand and 34.2% by its exports demand. The remaining 18.5% of total production was

induced by Vietnam's total final demand, broken down into: 8.1% by its final consumption demand, 3.4% by capital formation and 6.9% by exports demand. *It can thus be concluded that, in both countries, total output requirements were primarily induced by final consumption demand, followed by the demand for exports. Total induced output to meet capital formation or investment demand in both countries registered the least contribution ratios since their domestic demands rely heavily on supplies from the ROW.*

Table 15. Total (Direct & Indirect) Impact on Production

			THAILAND								VIETNAM								TOTAL
COUNTRY/SECTOR			FCE		GCF		Exports		TFD		FCE		GCF		Exports		TFD		
			US$bil	%	US$bil	%	US$bil	%	US$bil	%	US$bil	%	US$bil	%	US$bil	%	US$bil	%	
THA	I	AFF	9.78	7.0	-0.18	-0.5	5.94	4.7	15.54	5.2	0.03	0.1	0.01	0.0	0.01	0.0	0.04	0.1	15.58
	II	INDUSTRY	56.45	40.5	24.48	70.5	90.52	72.0	171.45	57.2	0.42	1.4	0.27	2.1	0.26	1.0	0.94	1.4	172.39
	III	SERVICES	73.03	52.4	10.28	29.6	29.08	23.1	112.38	37.5	0.30	1.0	0.07	0.6	0.10	0.4	0.47	0.7	112.86
	TOTAL - THAILAND		139.25	99.8	34.58	99.6	125.54	99.8	299.37	99.8	0.75	2.5	0.35	2.7	0.37	1.4	1.46	2.2	300.83
VIE	I	AFF	0.03	0.0	0.00	0.0	0.02	0.0	0.06	0.0	7.02	23.7	0.46	3.6	3.50	13.7	10.98	16.2	11.04
	II	INDUSTRY	0.11	0.1	0.07	0.2	0.14	0.1	0.31	0.1	11.37	38.3	10.54	83.1	15.07	59.1	36.98	54.5	37.30
	III	SERVICES	0.08	0.1	0.06	0.2	0.10	0.1	0.24	0.1	10.52	35.5	1.34	10.5	6.58	25.8	18.44	27.2	18.68
	TOTAL - VIETNAM		0.22	0.2	0.13	0.4	0.26	0.2	0.61	0.2	28.92	97.5	12.34	97.3	25.15	98.6	66.41	97.8	67.02
Totql INDUCED OUTPUT			139.47	100.0	34.71	100.0	125.80	100.0	299.98	100.0	29.67	100.0	12.69	100.0	25.51	100.0	67.87	100.0	367.85
Total FINAL DEMAND			82.43		21.28		79.56		183.27		18.93		7.74		16.68		43.35		226.62
OUTPUT MULTIPLIER			1.692		1.631		1.581		1.637		1.567		1.639		1.530		1.566		1.623
CONTRIBUTION RATIOS (%)																			
THA	I	AFF	62.7		-1.2		38.1		99.7		0.2		0.0		0.1		0.3		100.0
	II	INDUSTRY	32.7		14.2		52.5		99.5		0.2		0.2		0.2		0.5		100.0
	III	SERVICES	64.7		9.1		25.8		99.6		0.3		0.1		0.1		0.4		100.0
	TOTAL - THAILAND		46.3		11.5		41.7		99.5		0.2		0.1		0.1		0.5		100.0
VIE	I	AFF	0.3		0.0		0.2		0.5		63.6		4.2		31.7		99.5		100.0
	II	INDUSTRY	0.3		0.2		0.4		0.8		30.5		28.3		40.4		99.2		100.0
	III	SERVICES	0.4		0.3		0.5		1.3		56.3		7.2		35.2		98.7		100.0
	TOTAL - VIETNAM		0.3		0.2		0.4		0.9		43.2		18.4		37.5		99.1		100.0
Totql INDUCED OUTPUT			37.9		9.4		34.2		81.5		8.1		3.4		6.9		18.5		100.0

Abbreviations: FCE: Final Consumption Expenditure, GCF: Gross Capital Formation, TFD: Total final Demand, AFF: Agriculture, Fishery & Forestry

By sector, it can be seen that, in both countries, the bulk of output requirements for the major sectors of *agriculture, fishery & forestry* and *services* were induced by final consumption, while outputs in *industry* was induced largely by export demand. In conjunction with this finding, Table 15 also shows that Thailand's reliance on Vietnam's products to sustain its (Thailand's) final demand is less than Vietnam's dependence on Thailand's products. In 2000, Thailand imported from Vietnam US$0.61 billion worth of goods and services against US$1.46 billion worth imported by Vietnam from Thailand. This finding is consistent with Table 6A showing Vietnam's negative trade balance with Thailand.

From Table 10, it is also possible to determine the total output inducement coefficients or multipliers resulting from domestic final demands in both countries. It can be

observed that, in Thailand, average output requirement to satisfy final consumption demand exhibited the highest multiplier effect of 1.692 per unit of FCE, followed by investment demand (1.631) and export demand (1.581). In Vietnam, it is the demand for investment goods and services that showed the highest output multiplier effect of 1.639, followed by FCE and export demands with output multipliers of 1.567 and 1.530, respectively.

Impact on Value Added

In inter-regional analysis, the value added or income induced by the components of final demand can be calculated using the matrix equation:

$$\mathbf{V} = \mathbf{BLY} = \mathbf{BX} \tag{17}$$

where $\mathbf{V}$ is the matrix of value added induced by final demand; and $\mathbf{B}$ is matrix of value added or primary input coefficients.

Table 16, which presents the impact of final demand on the various factors of production for 2000, shows that 81.1% of the total GDP generated by the 2 economies totaling US$160.1 billion was induced by Thailand's final demand and the remaining 18.9% by Vietnam's final demand. Of the total labor income of US$57.2 billion, 70.1% was induced by Thailand's final demand and 29.9% by Vietnam's final demand, while 89.9% of the 2 economies' operating surplus was induced by Thailand's final demand, with the residual 10.1% by Vietnam's final demand. Approximately three-fourths (74.6%) of total net indirect tax payments generated in both economies was induced by Thailand's final demand and the remaining 25.4% was induced by Vietnam's final demand. The above findings intuitively suggest that, comparatively, Vietnam's economy in 2000 was more labor intensive than

Table 16. Total Impact on Income (GDP)
(Values are in Billion USD)

Factor of Production		THAILAND				VIETNAM				TOTAL
		Final Consump-tion	Gross Capital Formation	Exports	Total Final Demand	Final Consump-tion	Gross Capital Formation	Exports	Total Final Demand	
V1	Wages and salaries	23.0	3.8	13.3	40.1	8.8	2.1	6.2	17.1	57.2
V2	Operating Surplus	30.6	7.4	23.9	61.9	2.7	1.2	3.1	7.0	68.8
V3	Depreciation	9.1	2.2	7.0	18.2	1.2	0.5	1.3	3.0	21.3
V4	Indirect taxes less subsidies	4.7	1.0	3.8	9.6	1.5	0.5	1.3	3.3	12.8
GDP		67.3	14.5	48.0	129.7	14.3	4.2	11.8	30.3	160.1
TOTAL FINAL DEMAND		82.4	21.3	79.6	183.3	18.9	7.7	16.7	43.3	226.6
INCOME MULTIPLIER		0.816	0.681	0.603	0.708	0.756	0.543	0.708	0.700	0.706
CONTRIBUTION RATIOS (%)										
V1	Wages and salaries	40.2	6.7	23.2	70.1	15.5	3.6	10.8	29.9	100.0
V2	Operating Surplus	44.4	10.8	34.7	89.9	3.9	1.7	4.5	10.1	100.0
V3	Depreciation	42.6	10.3	32.8	85.8	5.8	2.4	6.0	14.2	100.0
V4	Indirect taxes less subsidies	36.5	8.2	29.9	74.6	11.9	3.7	9.8	25.4	100.0
GDP		42.0	9.1	30.0	81.1	8.9	2.6	7.4	18.9	100.0

Thailand's, while Thailand's economy was more profit-oriented than Vietnam's. Moreover, Vietnam's economy appeared to be more intense than Thailand's in terms of production tax generation.

In terms of income multipliers, final consumption had the highest GDP multipliers in both countries. This suggests that an increase in consumption demand will not only stimulate a relatively high level of output, but also GDP in both economies. The relatively high level of GDP generated in both countries by consumption suggests that such demand might be concentrated in industries with relatively low dependence on imports for production. Dividing the induced GVA for each of the three factors of production by their column sum results in measures of factor intensity that indicate whether the income induced by the components of final demand is labor-intensive and/or capital intensive.

As can be seen in Table 17, consumption-induced income in both countries could be said to be relatively labor-intensive as their wage and salary ratios are the highest among the 3 components of final demand. Likewise, investment-induced income in both countries tends to be relatively capital-intensive as their operating surplus and depreciation components exhibit the highest contribution ratios. In terms of net indirect taxes, export-induced income registers the highest ratio in Thailand, while investment-induced income appears to be relatively the largest contributor to government coffers in Vietnam.

Table 17. Factor Intensities

Factor of Production		THAILAND			VIETNAM		
		Final Consumption	Gross Capital Formation	Exports	Final Consumption	Gross Capital Formation	Exports
VV01	Wages and salaries	34.2	26.3	27.7	61.9	48.9	52.3
VV02	Operating Surplus	45.4	51.4	49.8	18.9	27.7	26.1
VV03	Depreciation	13.5	15.1	14.5	8.6	12.2	10.9
VV04	Indirect taxes less subsidies	6.9	7.2	8.0	10.7	11.3	10.7
GDP		100.0	100.0	100.0	100.0	100.0	100.0

Impact on Import Requirements

The non-competitive type of I-O table enables the quantification and assessment of the total imports needed by industries to sustain final demand. The total import requirements induced by the categories of final demand are obtained using the matrix equation:

$$\mathbf{M} = \hat{\mathbf{\Pi}}\,\mathbf{X} \qquad (18)$$

where $\mathbf{M}$ is the matrix of total (direct + indirect) intermediate import requirements induced by final demand; $\hat{\boldsymbol{\Pi}}$ is diagonal matrix of total imported intermediate input coefficients and $\mathbf{X}$ is matrix of total output requirements induced by final demand.

Table 18 shows the total (direct and indirect) import requirements by producing sectors to sustain the final demands in each country. In 2000, total imports from the ROW that producers needed in order to satisfy Thailand's final demands accounted for 80.5% of the combined induced import requirements of both countries, with the remaining 19.6% shared by Vietnam's economic activities. By sector, Table 18 shows that the largest bulk of importations were generally made by the industrial sectors in both countries, notably in Vietnam where its heavy manufacturing industries are observed to be heavily dependent on importations for their input requirements.

In terms of import multipliers, interpreted as the import contents per unit of final demands, Table 18 shows that exports to the ROW registered the highest total multiplier effect (0.397) among the 3 categories of final demand in Thailand's economy, followed by investment and consumption demands with import multiplier effects of 0.319 and 0.184, respectively. In Vietnam, its investment demand exhibited the highest total import multiplier effect (0.454), followed by export demand (0.299) and consumption demand (0.244).

Table 18. Total Import Requirements of Induced by Final Demands

COUNTRY/MAJOR SECTOR			THAILAND				VIETNAM				BILATERAL TOTAL
			Final Consump-tion	Gross Capital Formation	Exports	TFD	Final Consump-tion	Gross Capital Formation	Exports	TFD	
			%	%	%	%	%	%	%	%	%
THA	I	AGRI, FISHERY & FORESTRY	3.5	-0.1	1.0	1.6	0.0	0.0	0.0	0.0	1.3
	II	INDUSTRY	83.1	96.9	96.3	92.6	2.9	2.8	1.7	2.4	75.0
	III	SERVICES	13.1	2.8	2.5	5.5	0.2	0.0	0.1	0.1	4.5
		SUBTOTAL - THAILAND	99.7	99.5	99.8	99.8	3.1	2.9	1.8	2.6	80.8
VIE	I	AGRI, FISHERY & FORESTRY	0.0	0.0	0.0	0.0	17.2	1.3	7.9	9.5	1.9
	II	INDUSTRY	0.2	0.3	0.1	0.2	46.2	89.8	69.3	66.6	13.1
	III	SERVICES	0.1	0.1	0.1	0.1	33.4	6.0	20.9	21.3	4.2
		SUBTOTAL - VIETNAM	0.3	0.5	0.2	0.2	96.9	97.1	98.2	97.4	19.2
TOTAL INDUCED IMPORTS		%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		$mil [1]	15,137	6,779	31,591	53,507	4,611	3,515	4,851	12,977	66,483
FINAL DIRECT IMPORTS		[2]	11,514	10,789	0	22,304	3,809	1,546	0	5,355	27,659
TOTAL IMPORTS		[3]=[1]+[2]	26,651	17,568	31,591	75,810	8,419	5,061	4,851	18,332	94,142
TOTAL FINAL DEMAND		[4]	93,945	32,074	79,564	205,583	22,745	9,289	16,680	48,714	254,297
TOTAL IMPORT MULTIPLIER		[5]=[3]/[4]	0.284	0.548	0.397	0.369	0.370	0.545	0.291	0.376	0.370

One interesting observation of the results is the multiplier effect of (foreign) 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 I-O table, it can be

indirectly estimated as can be observed in Table 18. In Thailand's economy, its total import requirements induced by exports demand amounted to US$31.6 billion in 2000, which is then divided by its total export value of US$79.6 billion to yield an inducement coefficient or import multiplier of 0.397. In plain language, the finding suggests that, in order to sustain US$1,000 worth of demand for export goods and services, Thailand's production sectors need to import US$397 worth of intermediate inputs. In short, Thailand's net foreign exchange earning thus amounts to only US$603, calculated as the gross export receipt of US $1,000 less the import "leakage" of US$397.

Analogous estimation procedure used above is also applied in the case of Vietnam's export-induced total import multiplier effect of 0.291. It can thus be concluded that Vietnam's export-oriented products tended to be less import-dependent than Thailand's. Its estimated net foreign exchange income is therefore US$709 per US$1,000 gross export receipts.

V. CONCLUSION

Our paper has developed an IRIO model that links the neighboring economies of Thailand and Vietnam for the primary purpose of determining the extent of interdependencies among and between industries of the two countries. As a first attempt, the chosen reference year of this study is CY 2000 when the basic IO tables of both countries have readily been made available, thus making the compilation work of the bilateral IRIO table less difficult and time-consuming. The only remaining work then was the utter need to compile the trade flow tables linking the two economies.

In the absence of survey data due to budget constraint, the construction of the trade flow tables, specifically the import tables, made use of calculated bilateral trade coefficients. The compilation of export flows was not attempted; instead export trade flows were rationalized based on the calculated import flows, on the premise that imports of one partner country approximate the exports of the other partner country.

The reliability and quality of our results are heavily influenced by the accuracy and precision of the underlying data as well as methods used in our study. The IRIO table assumes that the estimated national input coefficients are stable over time. This assumption of stability entails two separate assumptions. One, it is assumed that the national technical coefficients are stable. Two, the bilateral trade coefficients are assumed to be stable as well. The first assumption is common to all IO tables, while the second assumption is unique in the sense that there are no overwhelming theoretical reasons for the stability of inter-regional trade coefficients, especially over the long run. Thus, while the IRIO table may be a useful device in predicting the short-run reaction path of the economies of both countries, any predictive use of the table over longer time periods will need to take into consideration any

variability in trading patterns. Thus, the need to update trading trends in the short run is imperative.

Intra-nationally, our comparative analysis revealed that, in CY 2000, Vietnam's economy was still in its developing stage as its total volume of economic transactions was estimated to be a mere one-fifth of Thailand's total available supply. Thailand had a per capita income more than five times that of Vietnam's. GVA in Vietnam was found to be split almost evenly across the agricultural and fishery, industry and services sectors, while GVA in Thailand was found to be dominated by the industrial and services sectors. On the whole, Thailand's economy was found to be self-sufficient, while average self-sufficiency rate in Vietnam was estimated to be below unity, i.e., its production is insufficient to sustain its domestic demand.

The analysis of the economic relationship between the two countries found that the value of their bilateral trade was much lower than their trading patterns with the Rest of the World (ROW). Consequently, the estimated international spillover and feedback effects were found to be rather negligible.

In terms of the degree of interdependencies, our results show that the multiplier effects, expressed in terms of backward and forward linkages, are observed to be higher in Thailand's productive economy than in Vietnam's. This suggests Thailand's higher dependence on its domestic industries, rather than on imports, for its input requirements than Vietnam's.

The impact analysis found that induced-consumption demand in both countries had the highest GVA and lowest imports multipliers. One likely reason for these results could be their relatively low dependence on imports for final consumption. On the other hand, induced-investment demand exhibited higher import multiplier effects since production of capital goods is highly dependent on imports.

One interesting observation of the results is the multiplier effect of export demand on the import requirements in production. While the import content of the production of export-oriented commodities cannot be directly measured from the I-O table, impact analysis revealed that production of export goods and services in Thailand was found to be more import-dependent than in Vietnam's. It can thus be concluded that, in terms of net foreign exchange earnings, which is estimated as the difference between gross export receipts and calculated import "leakages", appeared to be relatively more beneficial to Vietnam's economy than to Thailand's.

ACKNOWLEGEMENT

This study was supported by Grant-in-Aid for Scientific Research (B) from JSPS (2008-2010, head investigator is M.Morisugi in Meijyo University). Here shows special thanks for this Aid. And we wish to acknowledge the contribution to this paper as follows:

To Mr.Hedefumi.KANEKO, Vice president of AREES, for his invaluable technical advice on International IO compilation.

To Prof.Kiyoshi kobayashi, Dean, Kyoto University Graduate School of Management, Prof.Jiro Nemoto, Nagoya University Graduate School of Economy for his invaluable technical comment of preparation of this draft.

SELECTED REFERENCES

Chenery, H. B. 1956. *Interregional and International Input-Output Analysis* in T. Barna (ed.), The Structural Interdependence of the Economy. New York: John Wiley and Sons, Inc., pp. 341-356.

Chenery, H. B., and Clark, Paul G., 1959, *Interindustry Economics*, John Wiley & Sons, Inc., New York:

General Statistics Office, 2002. *Input-Output Table of Vietnam for 2000*. SNAD, GSO, Vietnam

Institute of Developing Economies-Japan External Trade Organization. 2006b. *Asian International Input-Output Table Volume 2: Data*. I.D.E. Statistical Data Series No. 90. Tokyo: IDE-JETRO.

Isard, W. 1951. *Interregional and Regional Input-Output Analysis: A Model of a Space-Economy*. Review of Economics and Statistics 33(4):318-328.

Isard, W., Azis, I. J., Drennan, M. P., Miller, R. E., Saltzman, S., Thorbecke, E. 1998. *Methods of Interregional and Regional Analysis*. Aldershot: Ashgate Publishing Limited.

Leontief, W. 1936. *Quantitative Input and Output Relations in the Economic Systems of the United States*. Review of Economic Statistics 18(3):105-125.

Miller, R. E. and Blair, P. D. 1985. *Input-Output Analysis: Foundations and Extensions*. New Jersey: Prentice-Hall, Inc.

National Economic and Social Development Board (NESDB), 2005. *Input-Output Table for Thailand 2000*

Rasmussen, P. N. 1957. *Studies in Inter-Sectoral Relations*. Amsterdam: North Holland Publishing Company.

Richardson, H. W. 1972. *Input-Output and Regional Economics*. London: Weidenfeld and Nicolson.

Kim.K, Trinh.B, Secretario, F, Hung, D. M., 2003. *Inter-Regional Input-Output Analysis: The Case of Ho Chi Minh City and the Rest of Vietnam Economies* , Vietnam's Socio-Economic Development No.43, pp14-38

Kim.K, Trinh.B, Secretario, 2005 The mutual impact between Hanoi and other regions in Vietnam, Vietnam's Socio-Economic Development No.45, pp64-80

AREES, 2007 AREES-NIS Private Joint Research Project on Construction of An IO table for Cambodia Economy 2000, Final Technical Report.

Kaneko.H, Secretario F, Kim.K, 2010, Compilation and Empirical Analysis of National IO table in Lao PDR, 2nd AREES international Joint Conference, Vientiane

Sim, B., Secretario, F. and Suan, E. 2007. *Developing an Interregional Input-Output Table for Savannakhet and Mukdahan: Methodology and Applications*. ERD Occasional Statistical Paper No. 1, Asian Development Bank, Manila, Philippines

United Nations Statistics Division. 1999. *Handbook of Input-Output Table: Compilation and Analysis*. Series F, No. 74. New York: United Nations.

Shunichi Furukawa, Arkhom Termpittayapaisith, 1999, Thailand-Indochina International Inter-Industrial Interdependency, IDE-JETRO