Decoupling and Sources of Structural Transformation of East Asian Economies: An International Input-Output Decomposition Analysis[1]

Jong-Hwan Ko
Division of International and Area Studies, Pukyong National University, Korea
jonghko@pknu.ac.kr

Werner Pascha
Mercator School of Management, University of Duisburg-Essen, Germany
werner.pascha@uni-due.de

This study aims to answer two questions using input-output decomposition analysis: 1) Have emerging Asian economies decoupled? 2) What are the sources of structural changes in gross outputs and value-added of emerging Asian economies related to the first question? The main findings of the study are as follows: First, since 1990, there has been a trend of increasing dependence on exports to extra-regions such as G3 and the ROW, indicating no sign of "decoupling", but rather an increasing integration of emerging Asian countries into global trade. Second, there is a contrasting feature in the sources of structural changes between non-China emerging Asia and China. Dependence of non-China emerging Asia on intra-regional trade has increased in line with strengthening economic integration in East Asia, whereas China has disintegrated from the region. Therefore, it can be said that China has contributed to no sign of decoupling of emerging Asia as a whole.

Keywords: Decoupling of emerging Asian economies, Asian International Input-Output tables, input-output decomposition analysis, sources of structural changes in gross outputs and value-added

JEL classification: F14, C67, E23

I. Introduction

Since the early 2000s, there has been a growing interest in the decoupling of an emerging Asia from the West. There are several reasons behind this. First, intra-regional trade and investment flows have increased remarkably, so it was of great interest to understand whether these changes were creating some degree of regional autonomy or whether they depended on Western final demand. One of the main drivers was the spectacular economic growth of China, which greatly contributed to the swelling intra-regional flows. Second, concerns about a potential structural weakness of Western demand also raised questions whether East Asia was already approaching a level of economic autonomy that enabled it to become one of the world´s growth poles. Third, deepening intra-regional economic integration can be interpreted as an important prerequisite for making progress towards an eventual economic and monetary union among Pacific Asian economies (Hasebe and Shrestha 2006), so also from a policy perspective

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it was meaningful to look into a possible decoupling of the region. Finally, it should not be underestimated that capital market players had promoted the idea of a decoupling of the East Asian region as well, in order to impress clients with a new investment idea (Willett et al. 2010; Pascha and Yoon 2011). For instance, Jim O´Neill of Goldman Sachs, who had invented the famous acronym BRICs (for the successful emerging economies of Brazil, Russia, India and China), was also described as the "main cheer leader" on decoupling in the Financial Times (Oakley 2009).

Broadly speaking, there are two different methods that have been used for an empirical study on the decoupling issue: an econometric method and input-output (I-O) analysis. Basically there are two different data that can be used for them: time series data (including panel data) and input-output (I-O) tables. An econometric study on decoupling needs time-series data. I-O analysis needs I-O tables.

A brief review of the literature on econometric studies on decoupling shows that the debate on decoupling is related to serious economic debates on the co-movement of global economies (e.g., Canova and Dellas 1993). Frankel and Rose (1998), for instance, empirically establish a relationship between trade links and business cycle correlations. This has informed a lot of works on such co-movements in the Asian region (e.g., Crosby 2003; Shin and Wang 2003; Sato and Zhang 2006; Fidrmuc and Korhonen 2009). By the mid 2000s, multilateral organizations had taken up the issue of decoupling in their publications (e.g., ADB 2007, 2008; IMF 2007), accompanied by studies done in association with such organizations (Kim et al. 2009; Rana 2006).

The results of such analyses, however, have been ambiguous. While some studies find a positive linkage between Asian trade interdependence and business cycle synchronization, others doubt it. Some find evidence for decoupling and others do not. To some extent, this ambiguity is related to different methodologies. For instance, while some authors look at the synchronization of business cycles by calculating correlations or by advanced forms of dynamic correlation analysis (e.g., Fidrmuc and Korhonen 2009), others turn to vector autoregression (VAR) models to better capture the interdependencies among multiple time series of national output data (e.g., Rana 2006; Dees and Vansteenkiste 2007; Kim et al. 2009). Different time frames of the analysis are also important. Several studies have argued that during the global financial crisis of 2007 to 2009, economic synchronization between the emerging Asian countries has considerably weakened again (e.g., Fidrmuc and Korhonen 2009; Willett et al. 2010). This could be related to the singular event of the global crisis, but could also point towards a cyclicality of the phenomenon of decoupling (Pascha and Yoon 2011).

One reason behind the ambivalent results could be that simple production or GDP data can be misleading about the true relationships among the output time series of East Asian economies. Due to the deepening of trade and investment relations among East Asian production networks along the supply chain, gross domestic output data may involve some serious double-counting and misinformation on the real sources of value-added.

Additionally, with the emergence of global production networks, trade data has become less accurate in describing the interdependences of the economies in emerging Asia. There are two main shortcomings of trade data (Pula and Peltonen 2009). First, trade statistics cannot capture the source of value-added, that is, cannot quantify the contribution of each country to the total value-added produced in the production chain. Thus, trade statistics provide inaccurate information about the dependence of each country in the production chain on external demand. Second, since trade data are gross statistics, they are prone to double-counting. The more the production is segmented across countries, the higher the total volume of trade will be, and thus, the more trade data overestimate the openness of emerging Asia as a region.

Input-output analysis offers a well-established approach to overcome such hurdles, though few studies have applied this approach to the East Asian decoupling debate.

The relevant data bases for such endeavors are the Asian International Input-Output (II-O) tables compiled by the Institute of Developing Economies – Japan External Trade Organization (IDE-JETRO). The Asian II-O tables provide detailed information on trade and production linkages between 10 economies in the Asia-Pacific region: China, Indonesia, Malaysia, the Philippines, Singapore, Korea, Taiwan, Thailand, Japan, and the United States.

At the time of writing this paper, the data was available only up to the year 2000, so applying the input-output tables to very recent phenomena like the effects of the global financial crisis is not possible. Mori and Sasaki (2007), however, update the Asian II-O table to 2005 by using the RAS method. They find that the production inducements among East Asian countries have increased further between 2000 and 2005, with China as a production base playing a particularly important role. Nevertheless, they cautiously argue that the economies of the region "have not necessarily become more autonomous" (ibid., p. 1) and are thus still exposed to countries outside of the region, particularly in the West.

Pula and Peltonen (2009) also update the 2000 Asian II-O table to 2006 in a similar way to Mori and Sasaki (2007), introducing two improvements: they differentiate the trade data used for the update by using different types of goods and thus account for the shift in the composition of trade from final to intermediate goods, and they adjust for the distorting Hong Kong entrepot trade[2]. Pula and Peltonen (2009) calculate the contribution ratios[3] of final demand to value-added for 1995, 2000 and 2006 and they find evidence for increasing global trade integration in emerging Asia, and thus against the decoupling thesis. While China and interregional trade have gained importance, there has not been a development towards autonomy; moreover, the simple trade figures overrate the role of the export sector of regional economies. With respect to extra-regional trading partners, Pula and Peltonen (2009) find an increasing dependence on the EU15 and on the rest of the world as well as a declining importance of the US and Japan.

According to the Asian Development Bank (2007), decoupling can be defined as "the emergence of a business cycle dynamic that is relatively independent of global demand trends and that is driven mainly by autonomous changes in internal demand". We use this definition of decoupling in the analysis of this paper. In this paper, we investigate whether emerging Asia has become a self-contained economic zone with the potential to maintain its own growth dynamism independent of global demand trends.

The method used in our paper is so-called input-output decomposition analysis (I-ODA), which is an extension of input-output analysis for which Wassily Leontief received Nobel Prize in Economics in 1973. I-ODA needs I-O tables and we use Asian II-O tables[4] for 1990 and

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[2] For more detailed information about the updating procedure see Appendix A.2 in Pula and Peltonen (2009).

[3] Pula and Peltonen (2009) define the contribution ratio (CR_i^j) of final demand from the demanding country *j* to the value-added of the supplying country *i* as $CR_i^j = IFv_i^j / \sum_j IFv_i^j$, where IFv_i^j stands for the *i*th row of matrix IFv^j, representing the impact of final demand from country *i* on the value-added of country *j*. IFv^j is calculated as follows: $IFv^j = \hat{v} * B * f^j$, where $\hat{v}$ is a diagonal matrix consisting of the elements of $v^j = v^j / x^j$ (the ratio of value-added *v* to total production *x* in country *j*), *B* is the Leontief inverse matrix, and f^j is a column vector of final demand in country *j*.

[4] Asian II-O tables have been compiled every five years. Asian II-O table for 2005 will be released by IDE-JETRO at the end of 2013. In 2010 when we started to work on this paper, Asian II-O tables compiled by IDE-JETRO for 1975, 1980, 1985, 1990, 1995 and 2000 were available. Therefore, we used

2000 compiled by IDE-JETRO and Asian II-O table for 2006 updated by Pula and Peltonen (2009).

By making a quantitative assessment of the sources of structural changes in gross output and value-added of emerging Asian economies (i.e., China, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Taiwan (Republic of China), and Thailand) between 1990 and 2000, as well as between 2000 and 2006, I-ODA makes it possible to examine whether they have decoupled.

The paper is organized as follows: In section 2, we discuss the methodology used in this study. Section 3 presents the sources of changes in total output and value-added of emerging Asian economies and Section 4 concludes with some remarks and suggestions for future work.

II. Data and Methodology

1. Data

We use Asian II-O tables for 1990 and 2000 compiled by the IDE-JETRO and the updated Asian II-O table for 2006 provided by Pula and Peltonen (2009)[5]. To date, the Asian II-O tables have been compiled for the years 1975, 1985, 1990, 1995 and 2000. The Asian II-O table for 2006 updated by Pula and Peltonen (2009) is the country-level update of the Asian II-O table for 2000, i.e., the Asian II-O table for 2006 is not disaggregated in sectors.

The structure of the Asian II-O table for 2000 is shown in Figure A.1 in the appendix. The Asian II-O table provides detailed information on the trade and production linkages of 10 economies in the Asia-Pacific region: China, Indonesia, Malaysia, the Philippines, Singapore, Korea, Taiwan, Thailand, Japan and the US. In addition, the geographical breakdown for trade includes Hong Kong Special Administration Region (SAR), the European Union (EU) and the rest of the world (ROW). The Asian II-O table contains the I-O tables of these countries linked together through trade matrices. In general, the Asian II-O table has both a country and a sectoral dimension, which makes it possible to describe the interdependences of various sectors of different countries. However, the Asian II-O table for 2006 used in this study is at a country level and we will focus on the aggregated country level throughout the analysis.[6]

As seen in Figure 1, the Asian II-O table consists of 5 matrices and 4 vectors: the intermediate input transaction matrix of 10 endogenous countries[7] (**AD**), the exogenous intermediate input transaction matrix (**AM**), which is a matrix of imported intermediate inputs from exogenous countries such as Hong Kong, the EU and the ROW, to the endogenous countries, the final demand matrix of the endogenous countries (**FD**), which is the transaction matrix of final goods and services among the endogenous countries, the exogenous final goods transaction matrix (**FM**), which is a matrix of imported final goods from the exogenous countries to the endogenous countries, the export matrix (**L**) of the endogenous countries to the exogenous ones, the value-added vector (**v**) of the endogenous countries, a vector of total inputs (**x'**), a vector of total outputs (**x**), and a vector of statistical discrepancy (**q**).

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another Asian II-O table for 2006 updated by Pula and Peltonen (2009).

[5] Time series of I-O tables at constant prices are needed for I-ODA. However, Asian II-O tables used in the paper are at current prices, not at constant prices. While empirical results using I-O tables at constant prices reflect changes in "quantity" only, empirical results using I-O tables at current prices show changes in a combination of "quantity" and "price".

[6] Due to the limited availability of data, Pula and Peltonen (2009) updated the Asian II-O table of 2000 to one for 2006 at the country level only.

[7] The 10 endogenous countries include Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Taiwan, Korea, Japan and US, as seen Figure A.1.

Figure 1: The Asian II-O table in matrix notation

	Intermediate demand	Final demand	Exports	Statistical discrepancy	Total outputs
	(AI) (AM)…(AU)	(AI) (AM)…(AU)	(LH) (LO) (LW)	(QX)	(XX)
(AI) (AM) … (AU)	**AD**	**FD**	**L**	**q**	**x**
(BF) (CH) … (DT)	**AM**	**FM**			
(VV)	**v**				
(XX)	**x'**				

The three main matrices of the Asian II-O table are the intermediate input transaction matrix (**AD**), the final demand matrix (**FD**) and the export matrix (**L**).

Let $\alpha^{ij} = \dfrac{ad^{ij}}{x^j}$, where α^{ij} are input coefficients, ad^{ij} are intermediate inputs from the supplying country *i* used in the production of the demanding country *j*, x^j is total production of the demanding country *j*, and *i* and *j* are indices of the supplying and demanding countries (i.e., Indonesia, Malaysia, Philippines, Singapore, Thailand, China, Taiwan, Korea, Japan and the US).

The Asian II-O table can be written in a matrix form as:

$$\begin{bmatrix} \alpha^{II} & \alpha^{IM} & . & \alpha^{IU} \\ \alpha^{MI} & \alpha^{MM} & . & \alpha^{MU} \\ . & . & . & . \\ \alpha^{UI} & \alpha^{UM} & . & \alpha^{UU} \end{bmatrix} x \begin{bmatrix} x^I \\ x^M \\ . \\ x^U \end{bmatrix} + \begin{bmatrix} FD^{II} & FD^{IM} & . & FD^{IU} \\ FD^{MI} & FD^{MM} & . & FD^{MU} \\ . & . & . & . \\ FD^{UI} & FD^{UM} & . & FD^{UU} \end{bmatrix} \iota + \begin{bmatrix} L^{IH} \, . \, L^{IW} \\ L^{MH} \, . \, L^{MW} \\ . \quad . \quad . \\ L^{UH} \, . \, L^{UW} \end{bmatrix} \iota + \begin{bmatrix} q^I \\ q^M \\ . \\ q^U \end{bmatrix} = \begin{bmatrix} x^I \\ x^M \\ . \\ x^U \end{bmatrix}$$

This matrix notation can be rewritten as equation (1).

$$\mathrm{A}x + FD\iota + L\iota + q = x \tag{1}$$

where ι is a unit vector in which each element is one and A is the intermediate input transaction matrix of 10 endogenous countries.

If we solve equation (1) to **x**, we get

$$x = (I - \mathrm{A})^{-1}(FD\iota + L\iota + q) \tag{2}$$

To simplify the notation, let $y = FD\iota + L\iota + q$ and $R = (I - \mathrm{A})^{-1}$. The equation (2) becomes

$$x = Ry \tag{3}$$

where **R** is the Leontief inverse matrix. The r^{ij} element of the matrix indicates the number of units of production needed in the supplying country *i* to meet one unit of the sum of final demand of the demanding country *j* for goods and services supplied by country *i* and exports of country *i* to the exogenous countries.

2. *Methodology*

I-ODA can be defined as a method for distinguishing major shifts of the structure of an economy by means of comparative static changes in key sets of parameters (Rose and Miernyk, 1989). I-ODA was first developed by Chenery (1960) and Chenery, Shishido and Watanabe (1962). I-ODA is based on the input-output model that provides a useful framework which makes it possible to examine the sources of differences in the structure of an economy between two years (or between countries). The differences in gross outputs between the base year *0* and the terminal year *1* can be identified in terms of two categories of structural changes that determine them: changes in the Leontief inverse matrix **R** and changes in the patterns of the final demand **y**, as seen in equation (4).

$$\Delta x = x^1 - x^0 = R^1 y^1 - R^0 y^0 \qquad (4)$$

The methodology of I-ODA is not unique. Decomposition methods can be different depending on weights to be used (Rose and Casler 1996; Dietzenbacher and Los 1998). For example, it is possible to use figures of the base year of observation or figures of the terminal year of observation as weights.

By rewriting equation (4), it is possible to decompose the growth of total output (Δ**x**) in terms of changes in the Leontief inverse (Δ**R**) and changes in the final demand (Δ**y**):

$$\Delta x = (R^1 - R^0) y^1 + R^0 (y^1 - y^0) = \Delta R y^1 + R^0 \Delta y \qquad (5)$$

or

$$\Delta x = (R^1 - R^0) y^0 + R^1 (y^1 - y^0) = \Delta R y^0 + R^1 \Delta y \qquad (6)$$

In both equations changes are weighted with figures of a different period. In equation (5), the differences in the Leontief inverse matrices are weighted with the terminal year's final demand, and the differences in final demand with the base year's inverse matrix.[8] In equation (6), the differences in the Leontief inverse matrices are weighted with the base year's final demand, and the differences in final demand with the Leontief inverse of the terminal year.[9] This causes a time inconsistency in the weights of the changes. To solve this inconsistency, the decomposition can be rewritten as

$$\begin{aligned} \Delta x &= R^1 y^1 (-R^0 y^0 + R^1 y^0) - R^1 y^0 + R^0 y^1 (-R^0 y^1 + R^0 y^0) - R^0 y^0 \\ &= \Delta R y^0 + R^0 \Delta y + \Delta R \Delta y, \end{aligned} \qquad (7)$$

or as

$$\begin{aligned} \Delta x &= R^1 y^1 (-R^0 y^0 + R^1 y^0) - R^1 y^0 + R^0 y^1 (-R^0 y^1 + R^1 y^1) - R^1 y^1 \\ &= \Delta R y^1 + R^1 \Delta y - \Delta R \Delta y. \end{aligned} \qquad (8)$$

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8 This approach was applied, for instance, by Skolka (1975, 1977, 1979), by Nijhowne et al. (1984), and Rose and Chen (1987).

9 This approach was used, for example, by Chenery, Shishido and Watanabe (1962), Stäglin and Wessels (1972), Syrquin (1976), Weiss and Wessels (1981), Kubo and Robinson (1984), Skolka (1984, 1989), and Ko (1993).

In equations (7) and (8), the changes are weighted by figures of the same year. Equations (5) to (8) give four possible but different decomposition methods. There is no clear theoretical reason as to why one of the methods is to be preferred. However, if the use of weights of the same base year is preferred, equations (7) and (8) are preferred to equations (5) and (6).

The last term of equations (7) and (8), $\Delta R \Delta y$, is interpreted as an interaction effect. It shows how much changes in total output can be attributed to a joint effect of changes in the Leontief inverse and changes in the final demand. A single interaction term appears only in a decomposition method with two factors (Dietzenbacher and Los 1998). As the number of factors increases, the number of interaction terms rises. A solution to this problem is obtained by deriving a method that does not include interaction effects. In the example of two factors, this can be done by taking the arithmetic average of equations (7) and (8). That is, changes in total output are expressed as

$$\Delta x = \frac{1}{2}\Delta R(y^0 + y^1) + \frac{1}{2}(R^0 + R^1)\Delta y, \tag{9}$$

which is another possible decomposition. Equation (9) can also be derived by taking the arithmetic average of equations (5) and (6). Hence, by choosing equation (9) all possible methods are taken into account. However, this holds only in the case of a decomposition analysis with two factors (Dietzenbacher and Los 1998).

Dietzenbacher and Los (1998) analyze to what extent the results of a decomposition analysis depend on the method chosen. They conclude that the choice of the method does not have much influence on average results, whereas it affects the effects of single sectors. For specific sectors, the outcomes of different methods may show large differences. Additionally, the differences increase, if the time lag increases. However, the average of several methods is more stable. The standard deviation of the average of several methods does not increase explicitly, even if the time lag increases. Therefore, it seems appropriate to use an average of several methods, which justifies the choice of equation (9) instead of one of the other four decomposition methods.

According to Dietzenbacher and Los (1998), the average of two specific decomposition methods, the so-called polar decomposition method, is very close to the average of all possible decomposition methods. Hence, this average of the polar decomposition methods, equation (9), is used in the decomposition analysis in this paper. The following section specifies the factors used to explain the changes in total output and the changes in value-added and derives the equations that follow from the chosen method.

Equation (9) can be rewritten as

$$\Delta x = \frac{1}{2}(R^1 - R^0)(y^0 + y^1) + \frac{1}{2}(R^0 + R^1)(y^1 - y^0). \tag{10}$$

We use equation (10) in this study. Since $R^1 - R^0 = R^1(\frac{1}{R^0} - \frac{1}{R^1})R^0 = R^1(\mathrm{A}^1 - \mathrm{A}^0)R^0$, the composition of changes in total outputs can be untangled by equation (11).

$$\Delta x = \frac{1}{2}R^1(A^1 - A^0)R^0(y^0 + y^1) + \frac{1}{2}(R^0 + R^1)(y^1 - y^0) \tag{11}$$

Since $y = FD\iota + L\iota + q$, equation (11) can be rewritten as

$$
\begin{aligned}
\Delta x &= \frac{1}{2}R^1(A^1 - A^0)R^0(y^0 + y^1) \\
&+ \frac{1}{2}(R^0 + R^1)(FL_\iota^{\ 1} - FL_\iota^{\ 0}) \\
&+ \frac{1}{2}(R^0 + R^1)(L_\iota^{\ 1} - L_\iota^{\ 0}) \\
&+ \frac{1}{2}(R^0 + R^1)(q^1 - q^0).
\end{aligned} \tag{12}
$$

Each term in equation (12) can be interpreted as its relative contribution to total outputs of the supplying countries as follows:

$\frac{1}{2}R^1(A^1 - A^0)R^0(y^0 + y^1)$: changes in input coefficients of the endogenous countries

$\frac{1}{2}(R^0 + R^1)(FL_\iota^{\ 1} - FL_\iota^{\ 0})$: expansion of final demand of the endogenous, demanding countries for goods and services provided by the supplying countries

$\frac{1}{2}(R^0 + R^1)(L_\iota^{\ 1} - L_\iota^{\ 0})$: expansion of exports to the exogenous, demanding countries

$\frac{1}{2}(R^0 + R^1)(q^1 - q^0)$: changes in statistical discrepancy

Since this study analyzes to what extent emerging East Asia is dependent on domestic final demand, final demand from the region itself, final demand from the advanced economies, in particular Japan, the US, and the EU15, and from the ROW, the contributions of domestic final demand, intra-regional final demand, extra-regional final demand, and exports to the G3 and the ROW to the total outputs of the supplying countries are computed. As the final demand for goods and services supplied by the 10 endogenous countries comes from the 10 endogenous countries and their exports go to 3 exogenous countries, the final demand of the 10 endogenous countries FD and their exports L are expressed by equations (10) and (11), respectively.

$$
FD\iota = f^I + f^M + f^P + f^S + f^T + f^C + f^N + f^K + f^J + f^U \tag{13}
$$

$$
L\iota = l^H + l^O + l^W \tag{14}
$$

where

f^I : final demand of Indonesia;

f^M : final demand of Malaysia;

f^P : final demand of the Philippines;

f^S : final demand of Singapore;

f^T : final demand of Thailand;

f^C : final demand of China;

f^N : final demand of Taiwan;

f^K : final demand of Korea;

f^J : final demand of Japan;

f^U : final demand of the US;

l^H : exports to Hong Kong;

l^O : exports to the EU15;

l^W : exports to the ROW

Therefore, the differences in gross outputs between the base year *0* and the terminal year *1* are computed by equation (15).

$$
\begin{aligned}
\Delta x &= \frac{1}{2}R^1(A^1 - A^0)R^0(y^0 + y^1) + \frac{1}{2}(R^0 + R^1)(f^{I^1} - f^{I^0}) \\
&+ \frac{1}{2}(R^0 + R^1)(f^{M^1} - f^{M^0}) + \frac{1}{2}(R^0 + R^1)(f^{P^1} - f^{P^0}) + \frac{1}{2}(R^0 + R^1)(f^{S^1} - f^{S^0}) \\
&+ \frac{1}{2}(R^0 + R^1)(f^{T^1} - f^{T^0}) + \frac{1}{2}(R^0 + R^1)(f^{C^1} - f^{C^0}) + \frac{1}{2}(R^0 + R^1)(f^{N^1} - f^{N^0}) \\
&+ \frac{1}{2}(R^0 + R^1)(f^{K^1} - f^{K^0}) + \frac{1}{2}(R^0 + R^1)(f^{J^1} - f^{J^0}) + \frac{1}{2}(R^0 + R^1)(f^{U^1} - f^{U^0}) \\
&+ \frac{1}{2}(R^0 + R^1)(l^{H^1} - l^{H^0}) + \frac{1}{2}(R^0 + R^1)(l^{O^1} - l^{O^0}) + \frac{1}{2}(R^0 + R^1)(l^{W^1} - l^{W^0}) \\
&+ \frac{1}{2}(R^0 + R^1)(q^1 - q^0).
\end{aligned} \tag{15}
$$

After the differences in gross outputs between the base year *0* and the terminal year *1* are computed by equation (15), the dependence of total outputs of emerging Asian economies on domestic final demand, final demand from the region itself, final demand from the G3 countries, and final demand from the ROW is calculated. By doing so, we get the measures to be used to answer the two questions raised as the objectives of this study, with respect to changes in gross outputs of emerging Asian economies.

Let $\alpha^{v^j} = \dfrac{v^j}{x^j}$, where α^{v^j} are the value-added coefficients of the demanding country *j*, and v^j are the value-added of the demanding country *j*. If the logic of equation (9) is applied, the difference in value-added between two periods can be expressed as

$$
\begin{aligned}
\Delta v &= v^1 - v^0 \\
&= \widehat{\alpha^v}^1 x^1 - \widehat{\alpha^v}^0 x^0 \\
&= \frac{1}{2}\Delta\widehat{\alpha^v}(x^0 + x^1) + \frac{1}{2}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)\Delta x \\
&= \frac{1}{2}(\widehat{\alpha^v}^1 - \widehat{\alpha^v}^0)(x^0 + x^1) + \frac{1}{2}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(x^1 - x^0)
\end{aligned} \tag{16}
$$

where $\widehat{\alpha^v}$ is a diagonal matrix consisting of the elements of $\alpha^{v^j} = v^j / x^j$.

If equation (12) is inserted into equation (16), the composition of changes in value-added can be untangled by equation (17).

$$
\begin{aligned}
\Delta v &= \frac{1}{2}(\widehat{\alpha^v}^1 - \widehat{\alpha^v}^0)(x^0 + x^1) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)R^1(\mathrm{A}^1 - \mathrm{A}^0)R^0(y^0 + y^1) \\
&+ \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(FL^1 - FL^0) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(L_\iota^1 - L_\iota^0) \\
&+ \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(q^1 - q^0).
\end{aligned} \tag{17}
$$

Each term in equation (17) can be interpreted as its relative contribution to value-added of the supplying countries as follows:

$\frac{1}{2}(\widehat{\alpha^v}^1 - \widehat{\alpha^v}^0)(x^0 + x^1)$: changes in value-added coefficients of the endogenous countries

$\frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)R^1(\mathrm{A}^1 - \mathrm{A}^0)R^0(y^0 + y^1)$: changes in technical input coefficients of the endogenous countries

$\frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(FD\iota^1 - FD\iota^0)$: expansion of final demand of the endogenous countries for goods and services provided by the supplying countries

$\frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(L\iota^1 - L\iota^0)$: expansion of exports to the exogenous countries

$\frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(q^1 - q^0)$: changes in statistical discrepancy

If the components of the final demand and destinations of exports are considered, as in equations (13) and (14), the differences in value-added between the base year *0* and the terminal year *1* can be computed by equation (18).

$$
\begin{aligned}
\Delta v = {} & \frac{1}{2}(\widehat{\alpha^v}^1 - \widehat{\alpha^v}^0)(x^0 + x^1) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)R^1(\mathrm{A}^1 - \mathrm{A}^0)R^0(y^0 + y^1) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{I^1} - f^{I^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{M^1} - f^{M^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{P^1} - f^{P^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{S^1} - f^{S^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{T^1} - f^{T^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{C^1} - f^{C^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{N^1} - f^{N^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{K^1} - f^{K^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{J^1} - f^{J^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(f^{U^1} - f^{U^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(l^{H^1} - l^{H^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(l^{O^1} - l^{O^0}) \\
& + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(l^{W^1} - l^{W^0}) + \frac{1}{4}(\widehat{\alpha^v}^0 + \widehat{\alpha^v}^1)(R^0 + R^1)(q^1 - q^0).
\end{aligned}
\tag{18}
$$

After the differences in value-added between the base year *0* and the terminal year *1* are computed by equation (18), the dependence of value-added of emerging Asian economies on domestic final demand, final demand from the region itself, final demand from the G3 countries, and final demand from the ROW is calculated. By doing so, we get the measures used to answer the two questions raised as the aims of this study, in regard of changes in value-added of emerging Asian economies.

IV. Results of I-ODA of Gross Outputs and Value-added of Emerging Asian Economies

The main findings of I-ODA of gross outputs and value-added of emerging Asian economies are summarized in Tables 1 and 2. Table 1 presents six factors contributing to changes in gross outputs of emerging Asian economies between two periods of time, 1990-2000 and 2000-2006: technical input coefficients, domestic demand, intra-regional demand (the sum of exports to emerging Asian economies), the G3 demand (exports to the EU, Japan and the US), exports to the ROW, and statistical discrepancy.

The contribution ratios are presented separately for the following supplying countries: emerging Asia (columns 2 and 3), emerging Asia without China (i.e., NIE3[10] and ASEAN4[11]) (columns 4 and 5), and China (columns 6 and 7).

The contribution ratio of the sum of domestic final demand and intra-regional final demand to gross output of emerging Asia between 1990-2000 and 2000-2006, decreased from 70.3% to 55.7%, while that of final demand from the G3 and the ROW increased from 24.8% to 26.7%. The changes in the impact of the final demand components show that since 1990, there has been a trend of increasing dependence of emerging Asia on exports to extra-regional markets, indicating no sign of "decoupling", but rather an increasing integration of emerging Asian countries into global trade. In other words, the exposure of emerging Asia to extra-regional markets has increased.

Table 1: Results of I-ODA of gross outputs of emerging Asian economies (%)

	Emerging Asia		Emerging Asia except China		China	
	1990-2000	2000-2006	1990-2000	2000-2006	1990-2000	2000-2006
1) Input coefficients	6.2	18.5	4.5	7.9	7.3	22.1
2) Domestic demand	67.0	51.0	54.5	50.4	75.5	51.3
3) Intra-regional demand	3.3	4.7	6.5	13.9	1.1	1.6
4) G3	15.0	11.4	19.4	8.1	12.0	12.6
EU	5.9	6.3	9.0	4.5	3.8	6.9
Japan	3.4	0.8	4.0	-0.2	3.0	1.1
US	5.7	4.4	6.4	3.7	5.2	4.6
5) ROW	9.8	15.3	15.5	18.6	6.0	14.2
6) Statistical discrepancy	1.3	-1.0	-0.4	1.1	-1.9	-1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculation

Although this study does not support the decoupling thesis for emerging Asia, there is a contrasting feature in the sources of structural changes in gross outputs between non-China emerging Asia and China. While the contribution ratio of the sum of domestic final demand and intra-regional final demand to gross outputs of non-China emerging Asia between 1990-2000 and 2000-2006 rose from 61% to 64.3%, that of China declined from 76.6% to 52.8%. Dependence of non-China emerging Asia on intra-regional trade has increased, in line with the strengthening of economic integration in Asia, but dependence of China on intra-regional trade has declined to a large extent. The contribution ratio of intra-regional demand to non-China emerging Asia's outputs increased drastically from 6.5% to 13.9% between 1990-2000 and 2000-2006, whereas that of intra-regional demand to China's output slightly rose from 1.1% to

[10] NIE3 includes Singapore, South Korea and Taiwan.

[11] ASEAN4 includes Indonesia, Malaysia, the Philippines and Thailand.

1.6%. However, the slight increase in importance of intra-regional demand for China's output was offset more by a drastic decrease in importance of its own domestic demand for China's output.

This contrasting feature of structural changes in gross outputs between non-China emerging Asia and China can also be seen in that, while the contribution ratio of final demand from the G3 and the ROW to gross outputs of non-China emerging Asia between 1990-2000 and 2000-2006 dropped from 34.9% to 26.7%, that of final demand from the G3 and the ROW to gross output of China rose from 18% to 26.8%.

Such contrasting features in the sources of structural changes in gross outputs between non-China emerging Asia and China demonstrate that since 1990, while China has shown a trend of increasing dependence on exports to extra-regional markets, indicating no sign of decoupling, non-China emerging Asia has strengthened its intra-regional dependence. Therefore, it can be said that China has contributed to no sign of decoupling in emerging Asia as a whole.

There have been differing trends in changes in the sources of extra-regional demand during the period 1990-2006. The contribution ratio of EU's demand to changes in gross outputs of emerging Asia increased between 1990-2000 and 2000-2006 from 5.9% to 6.3%, while the contribution ratios of Japan and the US declined from 3.4% to 0.8% and from 5.7% to 4.4%, respectively. As a result, the dependence of emerging Asia's outputs on the G3 economies decreased from 15% to 11.4%. However, the higher exposure of emerging Asia to extra-regional markets during 2000-2006 was due to stronger trade linkages with the ROW, with its contribution ratio for emerging Asia's gross outputs increasing 9.8% to 15.3% between 1990-2000 and 2000-2006.

Changes in input coefficients have also contributed to gross outputs of the emerging Asian economies. The contribution ratio of changes in input coefficients of emerging Asia to its gross output grew from 6.2% to 18.5% between 1990-2000 and 2000-2006, which implies increasingly deepening international production networks in the region. A comparison of changes in input coefficients between non-China emerging Asia and China shows that China has developed a deeper intra-regional production network than non-China emerging Asia in the same period of time: the contribution ratio of changes in input coefficients of China to its gross output grew from 7.3% to 22.1% between 1990-2000 and 2000-2006, whereas that of non-China emerging Asia from 4.5% to 7.9%.

Table 2 presents seven factors contributing to changes in value-added of the emerging Asian economies between 1990-2000 and 2000-2006: value-added coefficients, input coefficients, domestic demand, intra-regional demand, the G3 demand, exports to the ROW, and statistical discrepancy.

While changes in value-added coefficients of emerging Asia resulted in a decrease in its value-added, changes in input coefficients contributed to an increase in its value-added. The contribution ratio of value-added coefficients to emerging Asia's value-added decreased from -7.8% to -24.4% between 1990-2000 and 2000-2006, but that of input coefficients increased from 6.4% to 21.9%. Increases in efficiency in the use of primary factors of production ($\Delta\widehat{\alpha^{v}} = (\widehat{\alpha^{v}}^{1} - \widehat{\alpha^{v}}^{0})$) resulted in negative effects on value-added of Emerging Asia, i.e., less unit of primary factors of production was used to produce a unit of output. Substitution effects of primary factors of production by intermediate inputs are seen in emerging Asia, which implies that increased efficiency in the use of primary factors of production and increasingly deepening international production networks have occurred in the region at the same time.

Results of I-ODA of value-added of emerging Asia by domestic demand, intra-regional demand, and extra-regional demand in Table 2 are quite similar to those of gross outputs in

Table 1, except for China's dependence on the US market, with its higher contribution ratio during 2000-2006 than during 1990-2000 (6.2% vs. 5.8%). The contribution ratio of US demand to China's gross output decreased from 5.2% to 4.6% between 1990-2000 and 2000-2006, whereas that of US demand to China's value-added increased from 5.8% to 6.2%.

Table 2: Results of I-ODA of value-added of emerging Asian economies (%)

	Emerging Asia		Emerging Asia except China		China	
	1990-2000	2000-2006	1990-2000	2000-2006	1990-2000	2000-2006
1) Value-added coeff.	-7.8	-24.4	-3.7	-8.6	-11.3	-33.6
2) Input coefficients	6.4	21.9	4.3	8.9	8.2	29.5
3) Domestic demand	71.6	64.1	56.8	56.4	84.0	68.5
4) Intra-regional demand	3.7	6.7	6.8	14.7	1.2	2.1
5) G3	16.6	13.7	20.3	8.4	13.4	16.8
EU	6.5	7.5	9.3	4.8	4.2	9.2
Japan	3.8	0.9	4.3	-0.2	3.4	1.5
US	6.2	5.3	6.7	3.9	5.8	6.2
6) ROW	10.9	19.1	15.9	19.4	6.7	19.0
7) Statistical discrepancy	-1.4	-1.2	-0.4	0.8	-2.2	-2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculation

Table 2 indicates no sign of decoupling of emerging Asia in terms of value-added as well. The contribution ratio of the sum of domestic final demand and intra-regional final demand to value-added of emerging Asia between 1990-2000 and 2000-2006 decreased from 75.3% to 70.8%, while that of final demand from the G3 and the ROW increased from 27.5% to 32.8%.

The comparison of China with non-China emerging Asia by the sources of demand reveals a contrasting pattern. Dependence of non-China emerging Asia on domestic demand and intra-regional demand increased, but dependence of China on them decreased. In more detail, the contribution ratio of the sum of domestic demand and intra-regional demand to value-added of non-China emerging Asia rose from 63.6% to 71.1%, but the same ratio for China dropped from 85.2% to 70.6%. This indicates a contrasting feature of the strengthened economic integration of non-China emerging Asia within the region, with a higher degree of China's dependence on extra-regional export markets.

IV. Concluding Remarks

In this paper, we examined whether emerging Asian economies have decoupled, i.e. whether the business cycle dynamics in emerging Asia have recently become less sensitive to the global demand trends by making a quantitative assessment of the sources of their structural changes in gross outputs and value-added of emerging Asia, using I-ODA based on Asian II-O tables for 1990, 2000 and 2006. In particular, we investigated the dependence of emerging Asia's outputs and value-added through production and trade linkages on input coefficients and value-added coefficients, on domestic demand and intra-regional demand, on demand from the advanced economies, especially the EU, Japan and the US, and on demand from the ROW.

The main findings of the study are as follows. First, the changes in the impact of the final demand components on gross outputs and value-added of emerging Asia show that since 1990, there has been a trend of increasing dependence on exports to extra-regions such as G3 and the ROW, indicating no sign of “decoupling”, but rather an increasing integration of emerging Asian countries into global trade. In other words, the exposure of emerging Asia to extra-regional markets has increased. Second, although this study does not support the decoupling of emerging Asia, there is a contrasting feature in the sources of structural changes in gross output and value-added between non-China emerging Asia and China. Dependence of non-China emerging Asia on intra-regional trade has increased in line with strengthening economic integration in East Asia, whereas China has disintegrated from the region. Therefore, it can be said that China has contributed to no sign of decoupling of emerging Asia as a whole. Third, there have been differing trends in the changes amongst sources of extra-regional demand during 1990-2006. While the contribution ratio of EU’s demand to changes in gross outputs and value-added of emerging Asia increased between 1990-2000 and 2000-2006, the shares of Japan and the US declined. As a result, the dependence of emerging Asia’s output and value-added on the G3 economies decreased. However, the higher exposure of emerging Asia to extra-regional markets during 2000-2006 than during 1990-2000 was due to stronger trade linkages with the ROW, with its higher contribution ratio for emerging Asia’s gross outputs and value-added. Fourth, the contribution of domestic demand to emerging Asia’s output and value-added also decreased along with demand of G3 in the same period. In spite of an increase in intra-regional demand, the dependency on a combined total intra-regional demand (domestic demand + intra-regional demand) of emerging Asia decreased, because an increase in intra-regional demand was offset more by a decrease in domestic demand. Fifth, the contribution ratio of value-added coefficients to emerging Asia’s value-added decreased from -7.8% to -24.4% between 1990-2000 and 2000-2006, whereas that of input coefficients increased from 6.4% to 21.9%. Substitution effects of primary factors of production by intermediate inputs are seen in emerging Asia, which implies that increased efficiency in the use of primary factors of production and increasingly deepening international production networks have occurred in the region at the same time.

As is evident from the analysis, the paper finds no support for the decoupling view at the macroeconomic level. The picture at the industry level may look different. If the Asian II-O table for 2005 becomes available, another study for the same purpose at the sectoral level could be conducted.

References

Asian Development Bank (2007) Uncoupling Asia: Myth and Reality, *Asian Development Outlook 2007*.

Asian Development Bank (2008) The Global Slowdown in Emerging Asia, *Asian Development Outlook 2008*.

Athukorala, P. and A. Kohpaiboon (2009) Intra-Regional Trade in East Asia: The Decoupling Fallacy, Crisis, and Policy Challenges. *ADBI Working Paper No. 177, December*.

Balassa, B. (1979) Accounting for Economic Growth: The Case of Norway. *Oxford Economic Papers*, 41(3), pp. 415-436.

Canova, F. and H. Dellas (1993). Trade Interdependence and the International Business Cycle, Journal of International Economics, 34, pp. 23-47

Chenery, H.B. (1960) Patterns of Industrial Growth. *The American Economic Review*, 50, pp. 624-654.

Chenery, H.B., S. Shishido and T. Watanabe (1962) The Pattern of Japanese Growth, 1914-1954, *Econometrica*, 30(1), pp. 98-139.

Crosby, M. (2003) Business Cycle Correlations in the Asia-Pacific, *Economic Letters*, 80, pp. 35-44.

Dees, S. and I. Vansteenkiste (2007) The Transmission of US Cyclical Developments to the Rest of the World. *ECB Working Paper No. 798, August.*

Dietzenbacher, E. and Los, B. (1998) Structural Decomposition Techniques: Sense and Sensitivity, *Economic Systems Research*, 10(4), pp. 307-323.

Fay, J. and Fink, G. (1976) *Ein Input-Output-Vergleich der Brutto-Produktionsstruktur nach Wirtschaftsbereichen zwischen Ősterreich und Ungarn*. Vienna, Wiener Institut für internationale Wirtschaftsvergleiche.

Fidrmuc, J. and Korhonen, L. (2009) The impact of the global financial crisis on business cycles in Asian emerging economies. BOFIT Discussion Paper 11, Bank of Finland.

Frankel, Jeffrey A. and Rose, Andrew K. (1998) The Endogeneity of the Optimum Currency Area Criteria, *Economic Journal*, 108(449), pp. 1009-1025.

Hasebe, Y. and N. Shrestha (2006) Economic Integration in East Asia: An International Input-Output Analysis. *The World Economy*, 29(12), pp. 1709-1735.

International Monetary Fund (2007) Decoupling the Train? *World Economy Outlook 2007*, chapter 4, April.

Institute of Developing Economies Japan External Trade Organization (IDE-JETRO) (1998, 2006). *Asian International Input-Table 1990*, and *Asian International Input-Table 2000*, Tokyo.

Kim, S., J.-W. Lee, and C.-Y. Park (2009) Emerging Asia: Decoupling or Recoupling, *ADB Working Paper Series on Regional Economic Integration*, No. 31, June.

Ko, J.-H. (1993) *Ökonomische Analyse von Energie- und Volkswirtschaft auf der Basis allgemeiner Gleichgewichtsmodelle*. Frankfurt / Wien / Paris / New York, Peter Lang, Europäische Hochschulschriften, Vol. 1420.

Kubo, Y. and S. Robinson (1984) Sources of industrial growth and structural change: A comparative study of eight countries. *Proceedings of the Seventh International Conference on Input-Output Techniques*, United Nations, New York.

Leontief, W. (1941) *The Structure of American Economy, 1919-1929: An Empirical Application of Equilibrium Analysis*. Cambridge, MA, Harvard University Press.

Mori, T. and H. Sasaki (2007) Interdependence of Production and Income in Asia-Pacific Economies: An International Input-Output Approach. *Bank of Japan Working Paper No. 102, April*.

Nijhowne, S., S. Gribble, K. Hamilton and A. Syed (1984) Structural Change in the Canadian Economy 1961-1971. *Proceedings of the Seventh International Conference on Input-Output Techniques*, United Nations, New York, pp. 297-332.

Oakley, D. (2009) Decoupling gains brand new group of cheerleaders, *Financial Times*, 12 June, 25.

Pascha, W. and J. Yoon (2011) Are the East Asian economies decoupling? Empirical evidence

and rhetorical reasoning, *Copenhagen Journal of East Asian Studies,* 29(2), pp. 33-57.
Pula, G. and T.A. Peltonen (2009) Has Emerging Asia Decoupled? An Analysis of Production and Trade Linkages Using the Asian International Input-Output Table. *Working Paper Series No. 993, European Central Bank, January 2009.*
Rana, P. B. (2006) Economic Integration in East Asia: Trends, Prospects, and a Possible Roadmap, *ADB Working Paper Series on Regional Economic Integration*, No. 2.
Rose, A. and Casler, S. (1996) Input-Output Structural Decomposition Analysis: A Critical Appraisal, *Economic Systems Research*, 8(1), pp. 33-62.
Rose, A. and C. Y. Chen (1990) Sources of Change in Energy Use in the U.S. Economy, 1972-1982: A Structural Decomposition Analysis, *Resources and Energy*, Vol. 13, pp. 1-21.
Rose, A. and W. Miernyk (1989) Input-Output Analysis: The First Fifty Years, *Economic Systems Research*, 1(2), pp. 245-264.
Sato, K. and Z. Zhang (2006) Real Output Co-Movements in East Asia: Any Evidence for a Monetary Union? *The World Economy*, 29 (12), pp. 1671-1689.
Shin, K. and Y. Wang (2003) Trade integration and business cycle synchronization in East Asia, *Asian Economic Papers* 2(3), pp. 1-20.
Skolka, J. (1975) Importwachstum und Wirtschaftsstruktur - Eine Untersuchung auf Grund der Österreichischen Input-Output-Tabellen 1964 und 1970. *Empirica*, 1, 79-110.
Skolka, J. (1977) Input-Output Anatomy of Import Elasticities, *Empirical Economics*, 2, pp. 123-136.
Skolka, J. (1979) Shifts in Economic Structure and Import Dependency. A Comparative Input-Output Study for Seven European Countries. In: H. Giersch (ed.) *International Economic Development and Resource Transfer*. J. C. Mohr, Tebingen, pp. 435-452.
Skolka, J. (1984) Critical Comments on the Use of Input-output Models for the Analysis of Consequences of Income Redistribution in Developing Countries, in: H.P. Nissen (ed.) *Towards Income Distribution Policies*. EADI-Book Series 3. Tilburg, European Association of Development Research and Training Institutes.
Skolka, J. (1989) Input-Output Structural Decomposition Analysis for Austria, *Journal of Policy Modeling*, 11(1), pp. 45-66.
Stäglin, R. and H. Wessels (1972) Intertemporal analysis of structural change in the German economy, in: A. Bridy and A.P. Carter (eds.) *Input-Output Techniques*. Amsterdam, North Holland Publishing Company, pp. 370-92.
Syrquin, M. (1976) Sources of industrial growth and changes: an alternative measure (Paper presented at the European Meeting of Econometric Society, Helsinki).
Watanabe, T. (1964) An Experimental Comparison of Production Structures: EEC Countries and Japan, *Weltwirtschaftliches Archiv*, 92(1), pp. 409-425.
Watanabe, T. (1969) Approaches to the Problem of Intercountry Comparison of Input-Output Relations. A Survey and Suggestions for Further Research. *United Nations, International Comparisons of Interindustry Data*, New York, pp. 187-201.
Weiss, J-P. and H. Wessels (1980) “Strukturanalyse der Produktions- und der Beschäftigungsentwicklung in der Bundesrepublik Deutschland 1962-1972,” J. Frohn and R. Stäglin (eds.) *Empirische Wirtschaftsforschung: Konzeptionen, Verfahren und Ergebnisse*, Festschrift für Rolf Krengel aus Anlaβ seines 60. Geburtstages, Duncker & Humbolt: Berlin.
Willett, T. D., P. Liang and N. Zhang (2010) Global Contagion and the Decoupling Debate, Draft of 26 April 2010, Available from: www.cgu.edu/MSDocs/SPE/Decoupling_Draft_April26a_2010.doc [accessed in December 2010].

Appendix

Figure A.1: The schematic layout of the Asian II-O table for 2000

Figure A.1. The schematic layout of the 2000 Asian international Input-Output Table

The schematic image of the 2000 Asian international input-output table

		Intermediate Demand (A)									
	code	Indonesia (AI)	Malaysia (AM)	Philippines (AP)	Singapore (AS)	Thailand (AT)	China (AC)	Taiwan (AN)	Korea (AK)	Japan (AJ)	U.S.A. (AU)
Indonesia	(AI)	A^{II}	A^{IM}	A^{IP}	A^{IS}	A^{IT}	A^{IC}	A^{IN}	A^{IK}	A^{IJ}	A^{IU}
Malaysia	(AM)	A^{MI}	A^{MM}	A^{MP}	A^{MS}	A^{MT}	A^{MC}	A^{MN}	A^{MK}	A^{MJ}	A^{MU}
Philippines	(AP)	A^{PI}	A^{PM}	A^{PP}	A^{PS}	A^{PT}	A^{PC}	A^{PN}	A^{PK}	A^{PJ}	A^{PU}
Singapore	(AS)	A^{SI}	A^{SM}	A^{SP}	A^{SS}	A^{ST}	A^{SC}	A^{SN}	A^{SK}	A^{SJ}	A^{SU}
Thailand	(AT)	A^{TI}	A^{TM}	A^{TP}	A^{TS}	A^{TT}	A^{TC}	A^{TN}	A^{TK}	A^{TJ}	A^{TU}
China	(AC)	A^{CI}	A^{CM}	A^{CP}	A^{CS}	A^{CT}	A^{CC}	A^{CN}	A^{CK}	A^{CJ}	A^{CU}
Taiwan	(AN)	A^{NI}	A^{NM}	A^{NP}	A^{NS}	A^{NT}	A^{NC}	A^{NN}	A^{NK}	A^{NJ}	A^{NU}
Korea	(AK)	A^{KI}	A^{KM}	A^{KP}	A^{KS}	A^{KT}	A^{KC}	A^{KN}	A^{KK}	A^{KJ}	A^{KU}
Japan	(AJ)	A^{JI}	A^{JM}	A^{JP}	A^{JS}	A^{JT}	A^{JC}	A^{JN}	A^{JK}	A^{JJ}	A^{JU}
U.S.A.	(AU)	A^{UI}	A^{UM}	A^{UP}	A^{US}	A^{UT}	A^{UC}	A^{UN}	A^{UK}	A^{UJ}	A^{UU}
Freight and Insurance	(BF)	BA^{I}	BA^{M}	BA^{P}	BA^{S}	BA^{T}	BA^{C}	BA^{N}	BA^{K}	BA^{J}	BA^{U}
Import from Hong Kong	(CH)	A^{HI}	A^{HM}	A^{HP}	A^{HS}	A^{HT}	A^{HC}	A^{HN}	A^{HK}	A^{HJ}	A^{HU}
Import from EU	(CO)	A^{OI}	A^{OM}	A^{OP}	A^{OS}	A^{OT}	A^{OC}	A^{ON}	A^{OK}	A^{OJ}	A^{OU}
Import from the R.O.W.	(CW)	A^{WI}	A^{WM}	A^{WP}	A^{WS}	A^{WT}	A^{WC}	A^{WN}	A^{WK}	A^{WJ}	A^{WU}
Duties and Import Commodity Taxes	(DT)	DA^{I}	DA^{M}	DA^{P}	DA^{S}	DA^{T}	DA^{C}	DA^{N}	DA^{K}	DA^{J}	DA^{U}
Value Added	(VV)	V^{I}	V^{M}	V^{P}	V^{S}	V^{T}	V^{C}	V^{N}	V^{K}	V^{J}	V^{U}
Total Inputs	(XX)	X^{I}	X^{M}	X^{P}	X^{S}	X^{T}	X^{C}	X^{N}	X^{K}	X^{J}	X^{U}

		Final Demand (F)									
	code	Indonesia (FI)	Malaysia (FM)	Philippines (FP)	Singapore (FS)	Thailand (FT)	China (FC)	Taiwan (FN)	Korea (FK)	Japan (FJ)	U.S.A. (FU)
Indonesia	(AI)	F^{II}	F^{IM}	F^{IP}	F^{IS}	F^{IT}	F^{IC}	F^{IN}	F^{IK}	F^{IJ}	F^{IU}
Malaysia	(AM)	F^{MI}	F^{MM}	F^{MP}	F^{MS}	F^{MT}	F^{MC}	F^{MN}	F^{MK}	F^{MJ}	F^{MU}
Philippines	(AP)	F^{PI}	F^{PM}	F^{PP}	F^{PS}	F^{PT}	F^{PC}	F^{PN}	F^{PK}	F^{PJ}	F^{PU}
Singapore	(AS)	F^{SI}	F^{SM}	F^{SP}	F^{SS}	F^{ST}	F^{SC}	F^{SN}	F^{SK}	F^{SJ}	F^{SU}
Thailand	(AT)	F^{TI}	F^{TM}	F^{TP}	F^{TS}	F^{TT}	F^{TC}	F^{TN}	F^{TK}	F^{TJ}	F^{TU}
China	(AC)	F^{CI}	F^{CM}	F^{CP}	F^{CS}	F^{CT}	F^{CC}	F^{CN}	F^{CK}	F^{CJ}	F^{CU}
Taiwan	(AN)	F^{NI}	F^{NM}	F^{NP}	F^{NS}	F^{NT}	F^{NC}	F^{NN}	F^{NK}	F^{NJ}	F^{NU}
Korea	(AK)	F^{KI}	F^{KM}	F^{KP}	F^{KS}	F^{KT}	F^{KC}	F^{KN}	F^{KK}	F^{KJ}	F^{KU}
Japan	(AJ)	F^{JI}	F^{JM}	F^{JP}	F^{JS}	F^{JT}	F^{JC}	F^{JN}	F^{JK}	F^{JJ}	F^{JU}
U.S.A.	(AU)	F^{UI}	F^{UM}	F^{UP}	F^{US}	F^{UT}	F^{UC}	F^{UN}	F^{UK}	F^{UJ}	F^{UU}
Freight and Insurance	(BF)	BF^{I}	BF^{M}	BF^{P}	BF^{S}	BF^{T}	BF^{C}	BF^{N}	BF^{K}	BF^{J}	BF^{U}
Import from Hong Kong	(CH)	F^{HI}	F^{HM}	F^{HP}	F^{HS}	F^{HT}	F^{HC}	F^{HN}	F^{HK}	F^{HJ}	F^{HU}
Import from EU	(CO)	F^{OI}	F^{OM}	F^{OP}	F^{OS}	F^{OT}	F^{OC}	F^{ON}	F^{OK}	F^{OJ}	F^{OU}
Import from the R.O.W.	(CW)	F^{WI}	F^{WM}	F^{WP}	F^{WS}	F^{WT}	F^{WC}	F^{WN}	F^{WK}	F^{WJ}	F^{WU}
Duties and Import Commodity Taxes	(DT)	DF^{I}	DF^{M}	DF^{P}	DF^{S}	DF^{T}	DF^{C}	DF^{N}	DF^{K}	DF^{J}	DF^{U}
Value Added	(VV)										
Total Inputs	(XX)										

		Export (L)				
	code	Export to Hong Kong (LH)	Export to EU (LO)	Export to R.O.W. (LW)	Statistical Discrepan (QX)	Total Outputs (XX)
Indonesia	(AI)	L^{IH}	L^{IO}	L^{IW}	Q^{I}	X^{I}
Malaysia	(AM)	L^{MH}	L^{MO}	L^{MW}	Q^{M}	X^{M}
Philippines	(AP)	L^{PH}	L^{PO}	L^{PW}	Q^{P}	X^{P}
Singapore	(AS)	L^{SH}	L^{SO}	L^{SW}	Q^{S}	X^{S}
Thailand	(AT)	L^{TH}	L^{TO}	L^{TW}	Q^{T}	X^{T}
China	(AC)	L^{CH}	L^{CO}	L^{CW}	Q^{C}	X^{C}
Taiwan	(AN)	L^{NH}	L^{NO}	L^{NW}	Q^{N}	X^{N}
Korea	(AK)	L^{KH}	L^{KO}	L^{KW}	Q^{K}	X^{K}
Japan	(AJ)	L^{JH}	L^{JO}	L^{JW}	Q^{J}	X^{J}
U.S.A.	(AU)	L^{UH}	L^{UO}	L^{UW}	Q^{U}	X^{U}

* Each cell of A** and F** represents a matrix of 76 x 76 and 76 x 4 dimension, respectively.

Source: Institute of Developing Economies Japan External Trade Organization (IDE-JETRO) (2006), *Asian International Input-Table 2000*, Tokyo.