

Changes in Trade Intensity Between Korea and the Five Major ASEAN Countries in the Manufacturing Sector for the Period of 2003-2008*

KIM Seung Jin** · KIM GiSeung***

I . Introduction

The Korean economy has experienced dramatic changes during the last four decades. From a typical, underdeveloped agrarian economy, Korea emerged on the world stage as one of the front runners among the NIEs (newly industrializing economies). This outstanding economic achievement is truly remarkable considering the poor endowment of natural resources and the small domestic market. For this reason, the economic development strategy of Korea has been frequently referred to as a suitable model for other countries on the road to development.

* This work was supported by Hankuk University of Foreign Studies Research Fund of 2011.

** Professor, Department of International Economics and Law, Hankuk University of Foreign Studies. seunjkim@hufs.ac.kr

*** (Corresponding author) Assistant Professor, Department of Economics, Pusan National University. gsk@pusan.ac.kr

Korea, however, was on the verge of defaulting on her foreign loans at the end of November 1997, since her usable foreign exchange reserves fell rapidly to US dollar(US\$ in short hereafter) 7.3 billion, very far below a level enough to pay even one-month import bills. With the IMF bailout program along with financial assistance of other international communities, Korea could avoid the coldest winter ever in her history of phenomenal economic development for the last four decades. Although Korea successfully overcame financial crisis in August 2001 by repaying the IMF US\$ 15 billion that Korea borrowed as the IMF bailout program, the Korean economy suffered from a long-term recession from 2003 to 2007 since the previous Roh Moo Hyun government created an anti-business sentiment and put more emphasis on distribution rather than growth. Even though incumbent Korean government tried to boost up the Korean economy after taking office on 25 February 2008, their attempt did not turn out successful due to (a) political turmoil arising from imports of US beef and (b) global economic crisis arising from the US liquidity crisis which took place in September 2008. Thanks to (a) expansionary monetary and fiscal policies pursued by Korean government and (b) structural reforms in the field of corporate, financial, labor, and public sectors achieved after 1997 financial crisis, Korea emerged out as the first country which successfully overcame the global economic crisis in 2009.

In 2010 Korean exports to Indonesia rose to US\$ 8.90 billion (i.e., 1.9% of Korea's total exports) and Korean imports from Indonesia reached US\$ 13.99 billion (i.e., 3.3% of Korea's total imports). Consequently, Korea suffered from US\$ 5.09 billion trade deficit with

Indonesia. Likewise, Korean exports to Malaysia in 2010 rose to US\$ 6.11 billion (i.e., 1.3% of Korea's total exports) and Korean imports from Malaysia reached US\$ 9.53 billion (i.e., 2.2% of Korea's total imports). Accordingly, Korea suffered from US\$ 3.42 billion trade deficit with Malaysia.

On the other hand, Korean exports to Philippines in 2010 rose to US\$ 5.84 billion (i.e., 1.3% of Korea's total exports) and Korean imports from Philippines reached US\$ 3.49 billion (i.e., 0.8% of Korea's total imports). Consequently, Korea enjoyed US\$ 2.35 billion trade surplus with Philippines, which accounted for 5.7% of Korean trade surplus with the whole world. Likewise, Korean exports to Singapore in 2010 rose to US\$ 15.24 billion (i.e., 3.3% of Korea's total exports) and Korean imports from Singapore reached US\$ 7.85 billion (i.e., 1.8% of Korea's total imports). Accordingly, Korea enjoyed US\$ 7.39 billion trade surplus with Singapore, which accounted for 17.9 % of Korean trade surplus with the whole world.

In 2010 Korean exports to Thailand rose to US\$ 6.46 billion (i.e., 1.4% of Korea's total exports) and Korean imports from Thailand reached US\$ 4.17 billion (i.e., 1.0% of Korea's total imports). Consequently, Korea enjoyed US\$ 2.29 billion trade surplus with Thailand, which accounted for 5.6% of Korean trade surplus with the whole world.

Korea tries to enhance the economic cooperation with ASEAN countries through the FTA. Especially, Korea and Indonesia agree to launch the joint study for a Korea-Indonesia FTA on May, 2011 and have 1st round of the Korea-Indonesia joint study group meeting in Jakarta, Indonesia. Also, there was the 6th meeting of the joint study

group for a Korea-Vietnam FTA. Korea and Malaysia also agree to launch the feasibility study for a Korea-Malaysia FTA on May, 2011.

This paper analyzes how Korea's trade intensity with the five major ASEAN countries (i.e., Indonesia, Malaysia, Philippines, Singapore, and Thailand) changed over time for the last five years (i.e., from 2003 to 2008). For this purpose, Section 2 will briefly survey a trade intensity index model developed by Yamazawa (1970) and will measure a trade intensity index, a trade complementarity index, and a special country bias index between Korea and the five major ASEAN countries for the last five years by using the OECD trade matrix (2008). Section 3 will analyze the determinants of Korea's trade complementarity with the major ASEAN countries over the periods. Section 4 will summarize major empirical results and conclude the paper with a few remarks.

II. Trade Intensity, Trade Complementarity and Special Country Bias

1. Trade Intensity Index Model¹⁾

According to the Heckscher-Ohlin type of *two country two product two factor model*, trade patterns between countries will be determined by the *comparative advantage* structures between the two countries, determined by factor intensities of two products and factor

1) More detailed survey on the trade intensity model could be seen in pp. 125-131 in Kim (2004).

endowment ratios of two countries. In the multi-country model, however, various other factors are found to play important roles in determining trade patterns among those countries, as will be elaborated below.

Two alternative models have been developed for analyzing the world trade flows. One is a *gravity* model²⁾ and the other is a *trade intensity index* model. The trade intensity index model concentrates on the structure of departures of actual trade flows from trade flows estimated in gravity model. The index of intensity of country i's export trade with country j (in short, trade intensity index) is defined by

$$I_{ij} = \frac{X_{ij}}{X_i} / \frac{X_j}{X_{..}} \dots\dots\dots (1)$$

where X_i ($\equiv \sum_j X_{ij}$), X_j ($\equiv \sum_i X_{ij}$), and $X_{..}$ ($\equiv \sum_i \sum_j X_{ij}$) represent the total export of country i, total import of country j, and the total volume of world trade respectively. It is easily proved that, in a simplified gravity model where bilateral trade is solely determined by

2) The gravity model assumes that trade between two countries will mechanically be determined by the gross national products of exporting and importing countries and economic distance between the two. The GNP of an exporting country represents the size of her supply capacity and that of an importing country her total demand. The volume of trade between the two trading countries tends to increase if the GNP of either country increases, and tends to decrease, if the economic distance between them (measured in terms of transportation cost) increases. If this relationship holds between any pairs of countries, country i's export to country j (X_{ij}) can be defined as follows :

$$X_{ij} = \alpha Y_i^\beta Y_j^\gamma D_{ij}^{-\delta}$$

where Y_i , Y_j be the GNP's of country i and j, D_{ij} be the measure of economic distance between two countries, and α β γ δ be positive constants.

the GNPs of countries i and j , I_{ij} is always equal to unity.³⁾ In other words, I_{ij} equals unity if the value of trade is proportional to the GNPs of the two countries; exceeds unity if the trade becomes more intensive between the countries, and falls short of unity if trade becomes less intensive between the countries i and j . High trade intensity reflects such various factors as the strong complementarity in comparative advantage structures, smaller geographical and psychic distances, and mutually favorable trade agreements between the two countries.

This trade intensity index can be decomposed into trade complementarity index (C_{ij}) and special country bias index (B_{ij}) as follows.

Country i 's patterns of exports to and imports from the world are principally determined by its structure of comparative advantage and disadvantage vis-a-vis the world. Assuming a homogeneous commodity is traded in a world where both transport costs and artificial barriers to trade are negligible, the country i 's export of commodity h to country j (\bar{X}_{ij}^h) is expected to be the product of 「country j 's total import of the h -th commodity ($X_{.j}^h$)」 multiplied by 「the share of country i in the world trade (i.e., export) of commodity h ($X_i^h / X_{..}^h$)」 as follows.

$$\bar{X}_{ij}^h = X_{.j}^h \left(\frac{X_i^h}{X_{..}^h} \right) \dots\dots\dots (2)$$

In other words, the exporting country i 's expected market share in

3) Refer to footnote 4 in p 62 in Yamazawa (1970).

the importing country j's market in the trade of the h-th commodity ($\bar{X}_{ij}^h / X_{.j}^h$) is supposed to be determined by the exporting country i's market share in the world market in the trade of the same commodity ($X_i^h / X_{..}^h$) assuming that there are no trade barriers and no transportation costs.

This expected value of country i's export of commodity h to country j (\bar{X}_{ij}^h) can be rewritten as follows.

$$\bar{X}_{ij}^h = \frac{X_i^h X_{.j}^h}{X_{..}^h} \dots\dots\dots (3)$$

The expected value of total exports from country i to country j is defined as the sum of expected values of all commodities.

$$\bar{X}_{ij} \equiv \sum_h \bar{X}_{ij}^h \dots\dots\dots (4)$$

The country i's expected intensity of trade to country j (C_{ij}) or the country i's trade complementarity to country j (C_{ij}) is obtained by replacing the expected value of trade (\bar{X}_{ij}) for the actual one (X_{ij}) in the equation (1).

$$C_{ij} = \frac{\bar{X}_{ij}}{X_i} / \frac{X_{.j}}{X_{..}} \dots\dots\dots (5)$$

The divergence between the expected value of trade and the actual value defines the degree of special country bias as follows.

$$B_{ij} \equiv \frac{X_{ij}}{\bar{X}_{ij}} = \frac{X_{ij}}{\sum_h \bar{X}_{ij}^h} = 1 / \sum_h \left(\frac{X_{ij}^h}{\bar{X}_{ij}^h} \right) \frac{1}{B_{ij}^h} \dots\dots\dots (6)$$

where B_{ij}^h is the degree of special country bias in the trade of commodity h ($B_{ij}^h = X_{ij}^h / \bar{X}_{ij}^h$) and B_{ij} turns out to be a weighted harmonic mean of B_{ij}^h .

The first line of equation (6) gives a decomposition of trade intensity into two components as follows.

$$I_{ij} = C_{ij} \cdot B_{ij} \dots\dots\dots (7)$$

which is the basic formula for our analysis.

2. Determinants of Trade Complementarity

To find the determinants of trade complementarity (C_{ij}), it can be decomposed as follows :

$$\begin{aligned} C_{ij} &= \frac{\sum_h \bar{X}_{ij}^h}{X_{i.}} / \frac{X_{.j}}{X_{..}} \\ &= \sum_h \left(\frac{X_{i.}^h}{X_{i.}} \cdot \frac{X_{.j}^h}{X_{.j}} \cdot \frac{X_{..}^h}{X_{..}} \right) \\ &= \sum_h \left(\frac{X_{..}^h}{X_{..}} \right) \cdot \left(\frac{X_{i.}^h}{X_{i.}} / \frac{X_{..}^h}{X_{..}} \right) \cdot \left(\frac{X_{.j}^h}{X_{.j}} / \frac{X_{..}^h}{X_{..}} \right) \\ &= \sum_h \left(\frac{X_{..}^h}{X_{..}} \right) S_i^h \cdot R_j^h \dots\dots\dots (8) \end{aligned}$$

$$\text{where } S_i^h = \frac{X_{i.}^h}{X_{i.}} / \frac{X_{..}^h}{X_{..}}, \quad R_j^h = \frac{X_{.j}^h}{X_{.j}} / \frac{X_{..}^h}{X_{..}}$$

S_i^h and R_j^h are the shares of commodity h in country i's total exports and country j's total imports respectively both divided by commodity h's share in world total trade. They measure the degrees of country i's export specialization⁴⁾ and country j's import specialization in commodity h respectively. Since their weighted average over all commodities always takes a constant value of unity,

$$\sum_h \left(\frac{X_{i.}^h}{X_{i.}} \right) S_i^h = \sum_h \left(\frac{X_{.j}^h}{X_{.j}} \right) R_j^h = 1 \dots\dots\dots (9)$$

each of them takes value around unity. S_i^h of over (under) unity implies that country i exports commodity h more (less) intensively than the world average, and the higher (lower) the value of S_i^h the stronger (weaker) is country i's export specialization in commodity h. Similarly, the higher (lower) the value of R_j^h , the stronger (weaker) is country j's import specialization in commodity h.

The vector of S_i^h over all commodities, $(S_i^1, S_i^2, \dots, S_i^n)$, shows the structure of export specialization of country i, which reflects country i's structure of comparative advantage. Higher (lower) value of S_i^h indicates that country i has strong (weak) comparative advantage in the production of commodity h. The exactly same thing also applies to the vector of indices of import specialization. The structure of import specialization, however, is affected not only by the structure

4) S_i^h is nothing but an RCA (Revealed Comparative Advantage) index of country i for commodity h, which was introduced by Balassa (1965).

of comparative disadvantage but also by protective commercial policies much more than that of export specialization.

The degree of concentration or diversification of country i's export specialization and country j's import specialization is affected by such important aspects of comparative advantage as the size of a country, skewed resource endowments, etc.. They can be measured in terms of standard deviations of specialization indexes from their mean (i.e., unity), which are square roots of the variances defined as follows.

$$\begin{aligned} \sigma^2 (S_i) &= \sum_h \left(\frac{X^h}{\bar{X}} \right) (S_i^h - 1)^2 \\ \sigma^2 (R_j) &= \sum_h \left(\frac{X^h}{\bar{X}} \right) (R_j^h - 1)^2 \dots\dots\dots (10) \end{aligned}$$

It can be easily demonstrated that the lower the standard deviation of export (import) specialization index of a certain country, the more diversified the export (import) specialization pattern of the country.⁵⁾

Covariance of the indices of country i's export specialization and those of country j's import specialization is defined as follows.

$$\begin{aligned} COV (S_i , R_j) &= \sum_h \left(\frac{X^h}{\bar{X}} \right) (S_i^h - 1) (R_j^h - 1) \\ &= \sum_h \left(\frac{X^h}{\bar{X}} \right) (S_i^h R_j^h - S_i^h - R_j^h + 1) \\ &= \sum_h \left(\frac{X^h}{\bar{X}} \right) S_i^h R_j^h - \sum_h \left(\frac{X^h}{\bar{X}} \right) S_i^h - \sum_h \left(\frac{X^h}{\bar{X}} \right) R_j^h + \\ &\quad \sum_h \left(\frac{X^h}{\bar{X}} \right) \end{aligned}$$

5) Refer to pp. 65-66 in Yamazawa(1970).

$$\begin{aligned}
 &= \sum_h \left(\frac{X^h}{X^{\dots}} \right) S_i^h R_j^h - 1 - 1 + 1^6) \\
 &= \sum_h \left(\frac{X^h}{X^{\dots}} \right) S_i^h R_j^h - 1 \\
 &= C_{ij} - 1^7)
 \end{aligned}$$

or $C_{ij} = COV(S_i, R_j) + 1$ (11)

Therefore, if country i's pattern of export specialization matches country j's pattern of import specialization closely, that is, if the indices of country i's export specialization and country j's import specialization are positively correlated (i.e., $COV(S_i, R_j) > 0$), C_{ij} will take a value greater than unity. On the contrary, if they match poorly, that is, if they are negatively correlated (i.e., $COV(S_i, R_j) < 0$), C_{ij} will take a value less than unity. If they are independent ($COV(S_i, R_j) = 0$), C_{ij} will be equal to unity. Consequently, C_{ij} measures the degree of complementarity in the specialization structures of two trading countries.

The degree of complementarity, however, is not only influenced by the match of the specialization patterns of exports and imports, but also by their concentration or diversification. A country with highly concentrated pattern of export specialization tends to have higher complementarity in her export activities than the country with a similar but more diversified pattern of export specialization.⁸⁾

6) According to Equation (9), $\sum_h \left(\frac{X^h}{X^{\dots}} \right) S_i^h = \sum_h \left(\frac{X^h}{X^{\dots}} \right) R_j^h = 1$.

Furthermore, $\sum_h \left(\frac{X^h}{X^{\dots}} \right) = 1$.

7) By Equation (8).

Therefore, if the correlation coefficient between the specialization structure of exports and imports is calculated, the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification can be obtained as follows.

$$r_{ij} = \frac{COV(S_i, R_j)}{\sigma(S_i) \times \sigma(R_j)} \dots\dots\dots (12)$$

3. Korea's Trade Intensity, Trade Complementarity and Special Country Bias With the Five Major ASEAN Countries

To calculate Korea's trade intensity with the five major ASEAN countries for the last five years, the OECD trade matrix is used. As shown in Table 1, our basic sample of industries for the manufacturing sector consists of 35 industries. The classification of manufactured products by factor intensity and end uses is also listed in Table 2.

<Table 1> List of 35 Industries in Manufacturing Sector

SITC Code	Name of Industry	SITC Code	Name of Industry
51	Organic Chemicals	71	Power Generating Machinery And Equipment
52	Inorganic Chemicals	72	Specialized Machinery
53	Dyeing, Tanning And Coloring Materials	73	Metal Working Machinery
54	Medicinal and Pharmaceutical Products	74	Other Industrial Machinery and Parts
55	Essential Oils and Perfume Materials	75	Office Machines And ADP Equipment

8) Refer to the example of Table 1 in p 66 in Yamazama (1970).

56	Fertilizers	76	Telecommunications And Sound Recording Apparatus
57	Plastics in Primary Forms	77	Electrical Machinery, Apparatus And Appliances, n.e.s.
58	Plastics in Non-primary Forms	78	Road Vehicles
59	Chemical Materials and Products, n.e.s.	79	Other Transport Equipments
61	Leather, Leather Manufactures And Dressed Furskins	81	Prefabricated Buildings, Sanitary, Heating and Lighting Fixtures, n.e.s.
62	Rubber Manufactures, n.e.s.	82	Furniture and Parts Thereof
63	Cork and Wood Manufactures (excluding Furniture)	83	Travel Goods, Handbags, etc.
64	Paper and Paper Manufactures	84	Articles of Apparel And Clothing Accessories
65	Textile Yarn, Fabrics and Related Products	85	Footwear
66	Non-metallic Mineral Manufactures, n.e.s.	87	Professional and Scientific Instruments, n.e.s.
67	Iron and Steel	88	Photo Apparatus, Optical Goods, Watches and Clocks
68	Non-ferrous Metals	89	Miscellaneous Manufactured Articles, n.e.s.
69	Manufactures of Metal, n.e.s.		

<Table 2> Classification of Manufactured Products by Factor Intensity and End Uses

	SITC 2 digit Code
1) Labor-Intensive Products	61 63 65 66 69 76 81 82 83 84 85 89
2) Capital/Technology-Intensive Products	51 52 53 54 55 56 57 58 59 62 64 66 67 68 71 72 73 74 75 76 77 78 79 86 87 88 89
3) Nondurable Consumer Products	55 57 65 83 84 85 86 88 89
4) Durable Consumer Products	66 69 76 77 78 81 82 88 89
5) Capital Goods	69 71 72 73 74 75 77 78 79 87 88
6) Labor-Intensive Intermediate Products	61 63 65 66 69
7) Capital-Intensive Intermediate Products	51 52 53 54 55 56 58 59 62 64 66 67 68 88

Source : Ministry of International Trade and Industry, Government of Japan, White Paper on International Trade (1986: 405-406).

Korea's trade intensity, trade complementarity, and special country bias with the major ASEAN countries in the manufacturing sector for the period of 2003-2008 are displayed in Table 3. The results show that Korea's trade intensity with Indonesia decreased from 6.99 in 2003 to 6.74 in 2008, which advocates that Indonesia became *less important* as Korea's major trading partner over the last five years. This is totally due to the following two facts. One is that Korea's trade complementarity with Indonesia increased from 1.05 in 2003 to 1.11 in 2008, which means that Korea's export structure and an Indonesian import structure became *more complementary* with each other for the period of 2003-2008. The other is that Korea's special country bias with Indonesia decreased from 6.64 in 2003 to 6.06 in 2008 despite of the increase in Korea's foreign direct investment (FDI in short hereafter) to Indonesia from US\$ 134.1 million in 2003 to US\$ 541.3 million in 2008.

<Table 3> Korea's Trade Intensity, Trade Complementarity, and Special Country Bias With Indonesia, Malaysia, Philippines, Singapore, Thailand in the Manufacturing Sector: 2003, 2008

	Year	Indonesia	Malaysia	Philippines	Singapore	Thailand
Trade Intensity	2003	6.99	3.85	4.32	2.94	2.78
	2008	6.74	4.11	5.99	4.79	3.61
Trade Complementarity	2003	1.05	1.51	1.59	1.33	1.12
	2008	1.11	1.38	1.35	1.22	1.06
Special Country Bias	2003	6.64	2.56	2.72	2.20	2.49
	2008	6.06	2.97	4.43	3.94	3.39

Table 3 also tells us that Korea's trade intensity with Malaysia increased from 3.85 in 2003 to 4.11 in 2008, which proves that

Malaysia also became *more important* as Korea's major trading partner over the last five years. This is totally due to the following two facts. One is that Korea's trade complementarity with Malaysia decreased from 1.51 in 2003 to 1.38 in 2008, which means that Korea's export structure and a Malaysian import structure became *less complementary* with each other for the last five years. The other is that Korea's special country bias with Malaysia increased from 2.56 in 2003 to 2.97 in 2008, which might be partly due to the increase in Korea's FDI to Malaysia from US\$ 43.7 million in 2003 to US\$ 327.0 million in 2008.

Korea's trade intensity with Philippines also increased from 4.32 in 2003 to 5.99 in 2008, which proves that Philippines also became *more important* as Korea's major trading partner over the last five years. This is totally due to the fact that Korea's trade complementarity with Philippines decreased from 1.59 in 2003 to 1.35 in 2008, which means that Korea's export structure and Philippines' import structure became *less complementary* with each other for the last five years, even if Korea's special country bias with Philippines increased from 2.72 in 2003 to 4.43 in 2008 due to the increase in Korea's FDI to Philippines from US\$ 16.7 million in 2003 to US\$ 198.3 million in 2008.

Table 3 also tells us that Korea's trade intensity with Singapore was found to have increased from 2.94 in 2003 to 4.79 in 2008 due to (a) the decrease in Korea's trade complementarity with Singapore from 1.33 in 2003 to 1.22 in 2008, which means that Korea's export structure and a Singaporean import structure became *less complementary* with each other for the last five years and (b) the

increase in Korea's special country bias with Singapore from 2.20 in 2003 to 3.94 in 2008, which might result from the increase in Korea's FDI to Singapore from US\$ 235.4 million in 2003 to US\$ 550.6 million in 2008 .

Korea's trade intensity with Thailand also increased from 2.78 in 2003 to 3.61 in 2008 due to the increase in Korea's special country bias with Thailand from 2.49 in 2003 to 3.39 in 2008, which might be partly due to the increase in Korea's FDI to Thailand from US\$ 32.2 million in 2003 to US\$ 91.3 million in 2008. Korea's trade complementarity with Thailand, however, decreased from 1.12 in 2003 to 1.06 in 2008, which means that Korea's export structure and a Thai import structure became *less complementary* with each other for the last five years.

Korea's trade intensity with Indonesia in 2008 is the highest among her trade intensity with the five major ASEAN countries. This is totally due to the fact that Korea's special country bias with Indonesia is the highest among her equivalent value with the five major ASEAN countries, even if Korea's trade complementarity with Indonesia is the second lowest next to her trade intensity with Thailand. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and other four ASEAN countries (i.e., Malaysia, Thailand, Singapore, and Philippines) do reduce Korea's special country bias with these four countries and accordingly lessen her trade intensity with these four ASEAN countries, even if Korea's trade complementarity indices with Malaysia, Philippines, and Singapore are higher than her equivalent

value with Indonesia.

Korea's trade intensity with Philippines in 2008 is the second highest next to her trade intensity with Indonesia. This is totally due to the fact that Korea's special country bias with Philippines is again the second highest next to her equivalent value with Indonesia, along with the fact that Korea's trade complementarity with Philippines is the second highest in the order of its value among her equivalent values with these five ASEAN countries as shown in Table 3. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and other three ASEAN countries (i.e., Malaysia, Thailand, and Singapore) do reduce Korea's special country bias with these three countries and accordingly lessen her trade intensity with these three ASEAN countries.

Korea's trade intensity with Singapore in 2008 is the third highest next to her trade intensity with Indonesia and Philippines. This is totally due to the fact that Korea's special country bias with Singapore is the third highest next to her equivalent value with Indonesia and Philippines along with the fact that Korea's trade complementarity with Singapore is the third highest among her equivalent value with these five ASEAN countries listed in Table 3. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and Malaysia (Thailand) do reduce Korea's special country bias with Malaysia (Thailand) and accordingly lessen her trade intensity with Thailand (Malaysia).

III. Determinants of Korea's Trade Complementarity With Major ASEAN Countries

1. Determinants of Korea's Trade Complementarity With Indonesia

As shown in Table 4, Korea in both 2003 and 2008 has comparative advantage in the production of (a) labor-intensive product, such as *textile yarn, fabrics and related products (SITC 65)* and (b) capital/technology-intensive products, such as *telecommunications and sound recording apparatus (SITC 76), office machines and ADP equipment (SITC 75), electrical machinery, apparatus and appliances, n.e.s. (SITC 77), rubber manufactures, n.e.s.(SITC 62), and other transport equipments (SITC 79)* (refer to Table 2 for the classification of manufactured products by factor intensity and end uses. Also notice that in order to save the space of this paper only SITC code will be listed from now on. Please look at Table 1 for the name of each SITC code listed).

On top of these products, Korea in 2003 used to have comparative advantage in the production of labor-intensive product, such as *SITC 84*. In 2008 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *SITC 67, SITC 73, and SITC 87*.

<Table 4> Analysis of Korea's Trade Complementarity With Indonesia in Manufacturing Sector: 2003, 2008

SITC	2003					2008				
	S_k^h	R_l^h	$S_k^h \cdot R_l^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_k^h \cdot R_l^h$	S_k^h	R_l^h	$S_k^h \cdot R_l^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_k^h \cdot R_l^h$
51	0.29	1.21	0.35	0.04	0.01	0.50	1.05	0.53	0.04	0.02
52	0.30	1.33	0.39	0.01	0.00	0.43	1.01	0.44	0.01	0.00
53	0.31	2.03	0.63	0.01	0.00	0.31	1.65	0.51	0.01	0.00
54	0.03	0.28	0.01	0.06	0.00	0.04	0.19	0.01	0.07	0.00
55	0.10	0.82	0.08	0.01	0.00	0.11	0.88	0.09	0.01	0.00
56	0.09	2.41	0.21	0.00	0.00	0.27	4.65	1.26	0.00	0.01
57	0.65	1.77	1.15	0.02	0.02	0.79	1.11	0.88	0.02	0.02
58	0.73	0.65	0.48	0.01	0.01	0.78	0.51	0.40	0.01	0.00
59	0.29	1.84	0.53	0.02	0.01	0.25	1.55	0.39	0.02	0.01
61	0.14	2.96	0.41	0.00	0.00	0.28	2.84	0.78	0.00	0.00
62	1.34	0.76	1.03	0.01	0.01	1.41	1.14	1.60	0.01	0.02
63	0.04	0.27	0.01	0.01	0.00	0.03	0.26	0.01	0.01	0.00
64	0.34	0.63	0.21	0.03	0.01	0.27	0.59	0.16	0.02	0.00
65	1.53	2.30	3.52	0.02	0.07	1.15	0.82	0.95	0.01	0.01
66	0.33	0.60	0.20	0.02	0.00	0.33	0.48	0.16	0.02	0.00
67	0.88	1.96	1.73	0.03	0.05	1.37	1.82	2.49	0.05	0.12
68	0.26	1.58	0.40	0.02	0.01	0.38	1.43	0.55	0.03	0.02
69	0.73	1.08	0.79	0.03	0.02	0.79	0.92	0.73	0.03	0.02
71	0.29	1.45	0.42	0.04	0.02	0.41	1.42	0.58	0.05	0.03
72	0.54	2.28	1.24	0.03	0.04	0.93	2.74	2.54	0.04	0.10
73	0.52	2.70	1.40	0.01	0.01	1.19	2.05	2.45	0.01	0.02
74	0.62	1.47	0.91	0.05	0.05	0.66	1.43	0.94	0.06	0.06
75	2.59	0.51	1.32	0.05	0.06	1.34	0.45	0.61	0.03	0.02
76	3.95	1.42	5.62	0.04	0.25	5.07	1.00	5.08	0.05	0.24
77	2.08	1.34	2.79	0.08	0.23	1.90	1.15	2.18	0.07	0.16
78	0.97	0.49	0.47	0.18	0.09	0.87	0.64	0.56	0.16	0.09
79	1.27	1.02	1.30	0.03	0.04	1.92	2.02	3.89	0.03	0.11
81	0.25	0.22	0.05	0.00	0.00	0.14	0.17	0.02	0.01	0.00
82	0.14	0.17	0.02	0.01	0.00	0.14	0.17	0.02	0.01	0.00
83	0.65	0.06	0.04	0.00	0.00	0.18	0.13	0.02	0.00	0.00
84	1.62	0.11	0.18	0.02	0.00	0.51	0.07	0.04	0.02	0.00
85	0.51	0.35	0.18	0.01	0.00	0.16	0.23	0.04	0.00	0.00
87	0.24	0.57	0.13	0.03	0.00	1.02	0.74	0.76	0.03	0.02
88	0.39	0.58	0.23	0.01	0.00	0.54	0.45	0.24	0.01	0.00
89	0.59	0.45	0.26	0.05	0.01	0.45	0.30	0.13	0.05	0.01
Standard Deviation	0.81	0.81		$\Sigma=1$	$\Sigma=1.05$	0.90	0.95		$\Sigma=1$	$\Sigma=1.11$
Covariance & Correlation Coefficient	$COV(S_K, R_l)$ 0.05					$COV(S_K, R_l)$ 0.11				
	r_{KI} 0.09					r_{KI} 0.16				

On the other hand, Indonesia has comparative disadvantage in the production of (a) labor-intensive products, such as *SITC 61*, *SITC 65*, and *SITC 69* and (b) capital/technology-intensive products, such as *SITC 73*, *SITC 56*, *SITC 72*, *SITC 53*, *SITC 67*, *SITC 59*, *SITC 57*, *SITC 68*, *SITC 74*, *SITC 71*, *SITC 76*, *SITC 77*, *SITC 52*, *SITC 51*, and *SITC 79* in 2003.

In 2008, Indonesia continues to have comparative disadvantage in the production of (a) labor-intensive products, such as *SITC 61* and (b) capital/technology-intensive products, such as *SITC 56*, *SITC 72*, *SITC 73*, *SITC 79*, *SITC 67*, *SITC 53*, *SITC 59*, *SITC 74*, *SITC 68*, *SITC 71*, *SITC 77*, *SITC 62*, *SITC 57*, *SITC 51*, *SITC 52*, and *SITC 76*.

Consequently, Korea's promising and potential exportable products to Indonesia (i.e., the products which have a high value of $S_K^h \cdot R_I^h$ in Table 4) in 2003 turn out to be (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 76*, *SITC 77*, *SITC 67*, *SITC 73*, *SITC 75*, *SITC 79*, *SITC 72*, *SITC 57*, and *SITC 62*.

In 2008, Korea's promising and potential exportable products to Indonesia change to capital/technology-intensive products, such as *SITC 76*, *SITC 79*, *SITC 72*, *SITC 67*, *SITC 73*, *SITC 77*, *SITC 62*, and *SITC 56*.

The standard deviation of S_K^h increases from 0.81 in 2003 to 0.90 in 2008, which means that Korea's export specialization becomes *more concentrated* over the period. The standard deviation of R_I^h also increases from 0.81 in 2003 to 0.95 in 2008, which means that Indonesia's import specialization becomes *more concentrated* over the

period.

Since Korea's pattern of export specialization and Indonesia's pattern of import specialization were positively correlated in 2003 (i.e., $COV(S_K, R_I) = 0.05$), C_{KI} (i.e., Korea's trade complementarity with Indonesia) reached 1.05, which means that Korea's export structure and Indonesia's import structure were *complementary* with each other in 2003. As this positive covariance between Korea's pattern of export specialization and Indonesia's pattern of import specialization increased to 0.11 in 2008 (i.e., $COV(S_K, R_I) = 0.11$), C_{KI} reached 1.11, which means that Korea's export structure and Indonesia's import structure became *more complementary* with each other in 2008.

Accordingly, the correlation coefficient between Korea's export specialization structure and Indonesia's import specialization structure (i.e., r_{KI}), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification, increased from 0.09 in 2003 to 0.16 in 2008. This implies that Korea's export structure and Indonesia's import structure became *more complementary* with each other for the period of 2003-2008, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and Indonesia's pattern of import specialization.

The most important parts of the cooperation are resource development and refinery process in Indonesia and Korea's manufacturing know-how to better boost Indonesia's industrial base. The cooperation can be developed in the area of manufacturing-related industries like fertilizer and machinery.

2. Determinants of Korea's Trade Complementarity With Malaysia

As shown in Tables 4 and 5, Korea in both 2003 and 2008 has comparative advantage in the production of (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 76*, *SITC 75*, *SITC 77*, *SITC 62*, and *SITC 79*.

On top of these products, Korea in 2003 used to have comparative advantage in the production of labor-intensive product, such as *SITC 84*. In 2008 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *SITC 67*, *SITC 73*, and *SITC 87*.

On the other hand, Malaysia in 2003 has comparative disadvantage in the production of capital/technology-intensive products, such as *SITC 77*, *SITC 56*, *SITC 67*, *SITC 73*, *SITC 75*, *SITC 68*, *SITC 52*, *SITC 72*, and *SITC 87*. In 2008, Malaysia has comparative disadvantage in the production of capital/technology-intensive products, such as *SITC 77*, *SITC 56*, *SITC 79*, *SITC 68*, *SITC 72*, *SITC 87*, *SITC 67*, *SITC 75*, and *SITC 73*.

Consequently, Korea's promising and potential exportable products to Malaysia (i.e., the products which have a high value of $S_K^h \cdot R_M^h$ in Table 5) in 2003 turn out to be capital/technology-intensive products, such as *SITC 77*, *SITC 75*, *SITC 76*, and *SITC 67*.

<Table 5> Analysis of Korea's Trade Complementarity With Malaysia in Manufacturing Sector: 2003, 2008

SITC	2003					2008				
	S_K^h	R_M^h	$S_K^h \cdot R_M^h$	$\frac{X^h}{X_c}$	$\left(\frac{X^h}{X_c}\right) S_K^h \cdot R_M^h$	S_K^h	R_M^h	$S_K^h \cdot R_M^h$	$\frac{X^h}{X_c}$	$\left(\frac{X^h}{X_c}\right) S_K^h \cdot R_M^h$
51	0.29	0.38	0.11	0.04	0.00	0.50	0.25	0.13	0.04	0.01
52	0.30	1.17	0.34	0.01	0.00	0.43	0.88	0.38	0.01	0.00
53	0.31	0.86	0.27	0.01	0.00	0.31	0.82	0.25	0.01	0.00
54	0.03	0.19	0.01	0.06	0.00	0.04	0.24	0.01	0.07	0.00
55	0.10	0.44	0.04	0.01	0.00	0.11	0.44	0.05	0.01	0.00
56	0.09	1.84	0.16	0.00	0.00	0.27	2.07	0.56	0.00	0.00
57	0.65	0.76	0.49	0.02	0.01	0.79	0.68	0.54	0.02	0.01
58	0.73	0.63	0.46	0.01	0.01	0.78	0.63	0.49	0.01	0.01
59	0.29	0.71	0.20	0.02	0.00	0.25	0.84	0.21	0.02	0.00
61	0.14	0.29	0.04	0.00	0.00	0.28	0.51	0.14	0.00	0.00
62	1.34	0.28	0.37	0.01	0.00	1.41	0.28	0.39	0.01	0.00
63	0.04	0.14	0.01	0.01	0.00	0.03	0.17	0.01	0.01	0.00
64	0.34	0.53	0.18	0.03	0.00	0.27	0.58	0.16	0.02	0.00
65	1.53	0.32	0.49	0.02	0.01	1.15	0.33	0.38	0.01	0.01
66	0.33	0.44	0.15	0.02	0.00	0.33	0.64	0.21	0.02	0.00
67	0.88	1.42	1.25	0.03	0.04	1.37	1.18	1.61	0.05	0.07
68	0.26	1.25	0.32	0.02	0.01	0.38	1.49	0.57	0.03	0.02
69	0.73	0.48	0.35	0.03	0.01	0.79	0.48	0.38	0.03	0.01
71	0.29	0.58	0.17	0.04	0.01	0.41	0.72	0.29	0.05	0.01
72	0.54	1.11	0.60	0.03	0.02	0.93	1.43	1.33	0.04	0.05
73	0.52	1.37	0.71	0.01	0.01	1.19	1.10	1.31	0.01	0.01
74	0.62	0.81	0.50	0.05	0.03	0.66	0.85	0.55	0.06	0.03
75	2.59	1.35	3.50	0.05	0.17	1.34	1.13	1.52	0.03	0.05
76	3.95	0.85	3.37	0.04	0.15	5.07	0.72	3.64	0.05	0.17
77	2.08	5.25	10.91	0.08	0.91	1.90	5.16	9.81	0.07	0.71
78	0.97	0.34	0.33	0.18	0.06	0.87	0.34	0.30	0.16	0.05
79	1.27	0.77	0.98	0.03	0.03	1.92	1.60	3.07	0.03	0.08
81	0.25	0.15	0.04	0.00	0.00	0.14	0.23	0.03	0.01	0.00
82	0.14	0.20	0.03	0.01	0.00	0.14	0.17	0.02	0.01	0.00
83	0.65	0.11	0.07	0.00	0.00	0.18	0.26	0.05	0.00	0.00
84	1.62	0.05	0.08	0.02	0.00	0.51	0.06	0.03	0.02	0.00
85	0.51	0.03	0.01	0.01	0.00	0.16	0.05	0.01	0.00	0.00
87	0.24	1.04	0.25	0.03	0.01	1.02	1.26	1.29	0.03	0.04
88	0.39	0.62	0.24	0.01	0.00	0.54	0.74	0.40	0.01	0.00
89	0.59	0.36	0.21	0.05	0.01	0.45	0.34	0.15	0.05	0.01
Standard Deviation	0.81	0.90		$\Sigma=1$	$\Sigma=1.51$	0.90	0.89		$\Sigma=1$	$\Sigma=1.38$
Covariance & Correlation Coefficient	$COV(S_K, R_M)$ 0.51				r_{KM} 0.41	$COV(S_K, R_M)$ 0.38				r_{KM} 0.30

In 2008, Korea's promising and potential exportable products to Malaysia change to capital/technology-intensive products, such as *SITC 77*, *SITC 76*, *SITC 79*, *SITC 67*, *SITC 75*, *SITC 72*, *SITC 73*, and *SITC 87*.

As mentioned in sub-section 3.1, the standard deviation of S_K^h increases in the period of 2003-2008, which means that Korea's export specialization becomes *more concentrated* over time. The standard deviation of R_M^h , however, decreases from 0.90 in 2003 to 0.89 in 2008, which means that Malaysia's import specialization becomes *more diversified* over the period.

Since Korea's pattern of export specialization and Malaysia's pattern of import specialization were positively correlated in 2003 (i.e., $COV(S_K, R_M) = 0.51$), C_{KM} (i.e., Korea's trade complementarity with Malaysia) reached 1.51, which means that Korea's export structure and Malaysia's import structure were *complementary* with each other in 2003. As this positive covariance between Korea's pattern of export specialization and Malaysia's pattern of import specialization decreased to 0.38 in 2008 (i.e., $COV(S_K, R_M) = 0.38$), C_{KM} reached 1.38, which means that Korea's export structure and Malaysia's import structure became a little bit *less complementary* with each other in 2008.

Accordingly, the correlation coefficient between Korea's export specialization structure and Malaysia's import specialization structure (i.e., r_{KM}), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification, decreased from 0.41 in 2003 to 0.30 in 2008. This implies that Korea's export structure and Malaysia's import structure became *less complementary* with each other for the period of 2003-2008, if the degree of concentration or diversification was deleted from Korea's pattern

of export specialization and Malaysia's pattern of import specialization.

3. Determinants of Korea's Trade Complementarity With Philippines

As shown in Tables 4 to 6, Korea in both 2003 and 2008 has comparative advantage in the production of (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 76*, *SITC 75*, *SITC 77*, *SITC 62*, and *SITC 79*.

On top of these products, Korea in 2003 used to have comparative advantage in the production of labor-intensive product, such as *SITC 84*. In 2008 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *SITC 67*, *SITC 73*, and *SITC 87*.

On the other hand, Philippines in 2003 has comparative disadvantage in the production of capital/technology-intensive products, such as *SITC 77*, *SITC 75*, *SITC 87*, *SITC 56*, and *SITC 88*. In 2008, Philippines has comparative disadvantage in the production of capital/technology-intensive products, such as *SITC 77*, *SITC 79*, *SITC 88*, *SITC 72*, *SITC 87*, *SITC 56*, *SITC 75*, *SITC 53*, *SITC 59*, and *SITC 58*.

Consequently, Korea's promising and potential exportable products to Philippines (i.e., the products which have a high value of $S_K^h \cdot R_P^h$ in Table 6) in 2003 turn out to be (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 77*, *SITC 75*, and *SITC 76*.

<Table 6 > Analysis of Korea's Trade Complementarity With Philippines in Manufacturing Sector: 2003, 2008

SITC	2003					2008				
	S_K^h	R_P^h	$S_K^h \cdot R_P^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_P^h$	S_K^h	R_P^h	$S_K^h \cdot R_P^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_P^h$
51	0.29	0.35	0.10	0.04	0.00	0.50	0.35	0.18	0.04	0.01
52	0.30	0.48	0.14	0.01	0.00	0.43	0.91	0.39	0.01	0.00
53	0.31	0.71	0.22	0.01	0.00	0.31	1.11	0.34	0.01	0.00
54	0.03	0.31	0.01	0.06	0.00	0.04	0.42	0.02	0.07	0.00
55	0.10	0.54	0.05	0.01	0.00	0.11	0.67	0.07	0.01	0.00
56	0.09	1.10	0.10	0.00	0.00	0.27	1.22	0.33	0.00	0.00
57	0.65	0.62	0.40	0.02	0.01	0.79	0.58	0.46	0.02	0.01
58	0.73	0.71	0.52	0.01	0.01	0.78	1.00	0.78	0.01	0.01
59	0.29	0.70	0.20	0.02	0.00	0.25	1.11	0.28	0.02	0.01
61	0.14	0.70	0.10	0.00	0.00	0.28	0.74	0.20	0.00	0.00
62	1.34	0.37	0.50	0.01	0.01	1.41	0.44	0.62	0.01	0.01
63	0.04	0.25	0.01	0.01	0.00	0.03	0.29	0.01	0.01	0.00
64	0.34	0.48	0.16	0.03	0.00	0.27	0.81	0.22	0.02	0.00
65	1.53	0.89	1.36	0.02	0.03	1.15	0.53	0.62	0.01	0.01
66	0.33	0.53	0.18	0.02	0.00	0.33	0.73	0.24	0.02	0.00
67	0.88	0.74	0.65	0.03	0.02	1.37	0.88	1.20	0.05	0.06
68	0.26	0.64	0.16	0.02	0.00	0.38	0.70	0.27	0.03	0.01
69	0.73	0.64	0.47	0.03	0.01	0.79	0.60	0.47	0.03	0.02
71	0.29	0.58	0.17	0.04	0.01	0.41	0.49	0.20	0.05	0.01
72	0.54	0.84	0.46	0.03	0.02	0.93	1.32	1.23	0.04	0.05
73	0.52	0.96	0.50	0.01	0.00	1.19	0.99	1.19	0.01	0.01
74	0.62	0.60	0.37	0.05	0.02	0.66	0.78	0.51	0.06	0.03
75	2.59	1.55	4.01	0.05	0.19	1.34	1.17	1.58	0.03	0.05
76	3.95	0.88	3.47	0.04	0.15	5.07	0.60	3.06	0.05	0.15
77	2.08	5.77	12.01	0.08	1.00	1.90	5.29	10.07	0.07	0.73
78	0.97	0.22	0.21	0.18	0.04	0.87	0.28	0.24	0.16	0.04
79	1.27	0.55	0.70	0.03	0.02	1.92	1.56	3.00	0.03	0.08
81	0.25	0.13	0.03	0.00	0.00	0.14	0.19	0.03	0.01	0.00
82	0.14	0.17	0.02	0.01	0.00	0.14	0.20	0.03	0.01	0.00
83	0.65	0.15	0.10	0.00	0.00	0.18	0.13	0.02	0.00	0.00
84	1.62	0.06	0.09	0.02	0.00	0.51	0.05	0.03	0.02	0.00
85	0.51	0.08	0.04	0.01	0.00	0.16	0.10	0.02	0.00	0.00
87	0.24	1.13	0.27	0.03	0.01	1.02	1.32	1.35	0.03	0.04
88	0.39	1.02	0.39	0.01	0.00	0.54	1.35	0.72	0.01	0.01
89	0.59	0.47	0.27	0.05	0.01	0.45	0.62	0.28	0.05	0.01
Standard Deviation	0.81	0.94		$\Sigma=1$	$\Sigma=1.59$	0.90	0.87		$\Sigma=1$	$\Sigma=1.35$
Covariance & Correlation Coefficient	$COV(S_K, R_P)$				r_{KP}	$COV(S_K, R_P)$				r_{KP}
	0.59				0.43	0.35				0.27

In 2008, Korea's promising and potential exportable products to Philippines change to capital/technology-intensive products, such as *SITC 77, SITC 76, SITC 79, SITC 75, SITC 87, SITC 72, SITC 67,* and *SITC 73.*

As mentioned in sub-sections 3.1 and 3.2, the standard deviation of S_K^h increases in the period of 2003-2008, which means that Korea's export specialization becomes *more concentrated* over time. The standard deviation of R_P^h , however, decreases from 0.94 in 2003 to 0.87 in 2008, which means that Philippines' import specialization becomes *more diversified* over the period.

Since Korea's pattern of export specialization and Philippines' pattern of import specialization were positively correlated in 2003 (i.e., $COV(S_K, R_P) = 0.59$), C_{KP} (i.e., Korea's trade complementarity with Philippines) reached 1.59, which means that Korea's export structure and Philippines' import structure were *complementary* with each other in 2003. As this positive covariance between Korea's pattern of export specialization and Philippines' pattern of import specialization decreased to 0.35 in 2008 (i.e., $COV(S_K, R_P) = 0.35$), C_{KP} reached 1.35, which means that Korea's export structure and Philippines' import structure became a little bit *less complementary* with each other in 2008.

Accordingly, the correlation coefficient between Korea's export specialization structure and Philippines' import specialization structure (i.e., r_{KP}), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification, decreased from 0.43 in 2003 to 0.27 in 2008. This implies that Korea's export structure and Philippines' import structure

became *less complementary* with each other for the period of 2000-2005, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and Philippines' pattern of import specialization.

4. Determinants of Korea's Trade Complementarity With Singapore

As shown in Tables 4 to 7, Korea in both 2003 and 2008 has comparative advantage in the production of (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 76*, *SITC 75*, *SITC 77*, *SITC 62*, and *SITC 79*.

On top of these products, Korea in 2003 used to have comparative advantage in the production of labor-intensive product, such as *SITC 84*. In 2008 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *SITC 67*, *SITC 73*, and *SITC 87*.

On the other hand, Singapore in 2003 has comparative disadvantage in the production of capital/technology-intensive products, such as *SITC 79*, *SITC 77*, *SITC 88*, *SITC 75*, *SITC 87*, *SITC 72*, *SITC 59*, *SITC 53*, *SITC 71*, *SITC 73*, *SITC 74*, and *SITC 76*. In 2008, Singapore has comparative disadvantage in the production of (a) labor-intensive product, such as *SITC 83* and (b) capital/technology-intensive products, such as *SITC 79*, *SITC 77*, *SITC 88*, *SITC 72*, *SITC 71*, *SITC 87*, *SITC 75*, *SITC 74*, *SITC 59*, *SITC 53*, and *SITC 55*.

<Table 7> Analysis of Korea's Trade Complementarity With Singapore in Manufacturing Sector: 2003, 2008

SITC	2003					2008				
	S_K^h	R_S^h	$S_K^h \cdot R_S^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_S^h$	S_K^h	R_S^h	$S_K^h \cdot R_S^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_S^h$
51	0.29	0.66	0.19	0.04	0.01	0.50	0.56	0.28	0.04	0.01
52	0.30	0.71	0.21	0.01	0.00	0.43	0.51	0.22	0.01	0.00
53	0.31	1.14	0.35	0.01	0.00	0.31	1.14	0.35	0.01	0.00
54	0.03	0.24	0.01	0.06	0.00	0.04	0.27	0.01	0.07	0.00
55	0.10	0.77	0.08	0.01	0.00	0.11	1.05	0.11	0.01	0.00
56	0.09	0.06	0.01	0.00	0.00	0.27	0.03	0.01	0.00	0.00
57	0.65	0.82	0.53	0.02	0.01	0.79	0.79	0.62	0.02	0.02
58	0.73	0.73	0.54	0.01	0.01	0.78	0.58	0.46	0.01	0.01
59	0.29	1.22	0.35	0.02	0.01	0.25	1.35	0.34	0.02	0.01
61	0.14	0.16	0.02	0.00	0.00	0.28	0.25	0.07	0.00	0.00
62	1.34	0.54	0.72	0.01	0.01	1.41	0.43	0.61	0.01	0.01
63	0.04	0.06	0.00	0.01	0.00	0.03	0.06	0.00	0.01	0.00
64	0.34	0.31	0.10	0.03	0.00	0.27	0.27	0.07	0.02	0.00
65	1.53	0.29	0.44	0.02	0.01	1.15	0.27	0.31	0.01	0.00
66	0.33	0.55	0.19	0.02	0.00	0.33	0.53	0.18	0.02	0.00
67	0.88	0.78	0.68	0.03	0.02	1.37	0.75	1.02	0.05	0.05
68	0.26	0.62	0.16	0.02	0.00	0.38	0.56	0.22	0.03	0.01
69	0.73	0.76	0.55	0.03	0.02	0.79	0.84	0.67	0.03	0.02
71	0.29	1.14	0.33	0.04	0.01	0.41	1.84	0.75	0.05	0.03
72	0.54	1.26	0.69	0.03	0.02	0.93	1.99	1.85	0.04	0.07
73	0.52	1.13	0.59	0.01	0.00	1.19	0.87	1.04	0.01	0.01
74	0.62	1.12	0.69	0.05	0.04	0.66	1.40	0.92	0.06	0.06
75	2.59	1.73	4.49	0.05	0.21	1.34	1.45	1.95	0.03	0.07
76	3.95	1.02	4.04	0.04	0.18	5.07	0.69	3.52	0.05	0.17
77	2.08	3.08	6.41	0.08	0.54	1.90	2.93	5.58	0.07	0.40
78	0.97	0.21	0.20	0.18	0.04	0.87	0.22	0.19	0.16	0.03
79	1.27	3.85	4.90	0.03	0.15	1.92	3.26	6.27	0.03	0.17
81	0.25	0.30	0.07	0.00	0.00	0.14	0.36	0.05	0.01	0.00
82	0.14	0.19	0.03	0.01	0.00	0.14	0.19	0.03	0.01	0.00
83	0.65	0.42	0.28	0.00	0.00	0.18	1.76	0.32	0.00	0.00
84	1.62	0.13	0.21	0.02	0.00	0.51	0.18	0.09	0.02	0.00
85	0.51	0.11	0.05	0.01	0.00	0.16	0.16	0.02	0.00	0.00
87	0.24	1.54	0.36	0.03	0.01	1.02	1.46	1.49	0.03	0.05
88	0.39	1.82	0.70	0.01	0.01	0.54	2.43	1.30	0.01	0.01
89	0.59	0.62	0.36	0.05	0.02	0.45	0.67	0.30	0.05	0.01
Standard Deviation	0.81	0.81		$\Sigma=1$	$\Sigma=1.33$	0.90	0.81		$\Sigma=1$	$\Sigma=1.22$
Covariance & Correlation Coefficient	$COV(S_K, R_S)$				r_{KS}	$COV(S_K, R_S)$				r_{KS}
	0.33				0.38	0.22				0.24

Consequently, Korea's promising and potential exportable products to Singapore (i.e., the products which have a high value of $S_K^h \cdot R_S^h$ in Table 7) in 2003 turn out to be capital/technology-intensive products, such as *SITC 77*, *SITC 79*, *SITC 75*, and *SITC 76*.

In 2008, Korea's promising and potential exportable products to Singapore change to capital/technology-intensive products, such as *SITC 79*, *SITC 77*, *SITC 76*, *SITC 75*, *SITC 72*, *SITC 87*, *SITC 88*, *SITC 73*, and *SITC 67*.

As mentioned in sub-sections 3.1 to 3.3, the standard deviation of S_K^h increases in the period of 2003-2008, which means that Korea's export specialization becomes *more concentrated* over time. The standard deviation of R_S^h remains fixed at 0.81 in both 2003 and 2008, which means that Singapore's import specialization becomes *neither more concentrated nor more diversified* over the period.

Since Korea's pattern of export specialization and Singapore's pattern of import specialization were positively correlated in 2003 (i.e., $COV(S_K, R_S) = 0.33$), C_{KS} (i.e., Korea's trade complementarity with Singapore) reached 1.33, which means that Korea's export structure and Singapore's import structure were *complementary* with each other in 2003. As this positive covariance between Korea's pattern of export specialization and Singapore's pattern of import specialization decreased to 0.22 in 2008 (i.e., $COV(S_K^h, R_S^h) = 0.22$), C_{KS} reached 1.22, which means that Korea's export structure and Singapore's import structure became a little bit *less complementary* with each other in 2008.

Accordingly, the correlation coefficient between Korea's export specialization structure and Singapore's import specialization structure

(i.e., r_{KS}), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification, decreased from 0.38 in 2003 to 0.24 in 2008. This implies that Korea's export structure and Singapore's import structure became *less complementary* with each other for the period of 2003-2008, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and Singapore's pattern of import specialization.

5. Determinants of Korea's Trade Complementarity With Thailand

As shown in Tables 4 to 8, Korea in both 2003 and 2008 has comparative advantage in the production of (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 76*, *SITC 75*, *SITC 77*, *SITC 62*, and *SITC 79*.

On top of these products, Korea in 2003 used to have comparative advantage in the production of labor-intensive product, such as *SITC 84*. In 2008 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *SITC 67*, *SITC 73*, and *SITC 87*.

On the other hand, Thailand in 2003 has comparative disadvantage in the production of (a) labor-intensive products, such as *SITC 61* and (b) capital/technology-intensive products, such as *SITC 73*, *SITC 56*, *SITC 67*, *SITC 77*, *SITC 72*, *SITC 68*, *SITC 74*, *SITC 53*, *SITC 66*, *SITC 59*, *SITC 57*, *SITC 79*, *SITC 88*, *SITC 87*, *SITC 52*, and *SITC 71*. In 2008, Thailand has comparative disadvantage in the production of (a) labor-intensive products, such as *SITC 61* and (b)

<Table 8> Analysis of Korea's Trade Complementarity With Thailand in Manufacturing Sector: 2003, 2008

SITC	2003					2008				
	S_K^h	R_T^h	$S_K^h \cdot R_T^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_T^h$	S_K^h	R_T^h	$S_K^h \cdot R_T^h$	$\frac{X^h}{X}$	$\left(\frac{X^h}{X}\right) S_K^h \cdot R_T^h$
51	0.29	0.76	0.22	0.04	0.01	0.50	0.62	0.31	0.04	0.01
52	0.30	1.02	0.30	0.01	0.00	0.43	1.45	0.63	0.01	0.01
53	0.31	1.52	0.47	0.01	0.00	0.31	1.41	0.44	0.01	0.00
54	0.03	0.29	0.01	0.06	0.00	0.04	0.33	0.01	0.07	0.00
55	0.10	0.69	0.07	0.01	0.00	0.11	0.67	0.07	0.01	0.00
56	0.09	2.86	0.25	0.00	0.00	0.27	1.06	0.29	0.00	0.00
57	0.65	1.14	0.74	0.02	0.02	0.79	1.06	0.84	0.02	0.02
58	0.73	0.97	0.71	0.01	0.01	0.78	0.86	0.67	0.01	0.01
59	0.29	1.16	0.33	0.02	0.01	0.25	1.68	0.42	0.02	0.01
61	0.14	1.85	0.26	0.00	0.00	0.28	1.61	0.44	0.00	0.00
62	1.34	0.46	0.62	0.01	0.01	1.41	0.51	0.72	0.01	0.01
63	0.04	0.08	0.00	0.01	0.00	0.03	0.09	0.00	0.01	0.00
64	0.34	0.40	0.14	0.03	0.00	0.27	0.54	0.14	0.02	0.00
65	1.53	0.94	1.43	0.02	0.03	1.15	0.91	1.05	0.01	0.02
66	0.33	1.40	0.47	0.02	0.01	0.33	1.33	0.44	0.02	0.01
67	0.88	2.58	2.27	0.03	0.07	1.37	2.53	3.45	0.05	0.16
68	0.26	1.59	0.41	0.02	0.01	0.38	1.60	0.61	0.03	0.02
69	0.73	0.76	0.55	0.03	0.02	0.79	0.83	0.66	0.03	0.02
71	0.29	1.00	0.29	0.04	0.01	0.41	1.27	0.52	0.05	0.02
72	0.54	1.95	1.06	0.03	0.04	0.93	1.63	1.52	0.04	0.06
73	0.52	3.44	1.78	0.01	0.01	1.19	2.95	3.52	0.01	0.03
74	0.62	1.53	0.95	0.05	0.05	0.66	1.34	0.88	0.06	0.05
75	2.59	0.91	2.35	0.05	0.11	1.34	0.95	1.27	0.03	0.04
76	3.95	0.99	3.90	0.04	0.17	5.07	0.52	2.66	0.05	0.13
77	2.08	2.23	4.64	0.08	0.39	1.90	2.06	3.91	0.07	0.28
78	0.97	0.41	0.40	0.18	0.07	0.87	0.44	0.38	0.16	0.06
79	1.27	1.11	1.41	0.03	0.04	1.92	0.73	1.40	0.03	0.04
81	0.25	0.12	0.03	0.00	0.00	0.14	0.17	0.02	0.01	0.00
82	0.14	0.18	0.02	0.01	0.00	0.14	0.24	0.03	0.01	0.00
83	0.65	0.15	0.10	0.00	0.00	0.18	0.28	0.05	0.00	0.00
84	1.62	0.05	0.09	0.02	0.00	0.51	0.08	0.04	0.02	0.00
85	0.51	0.10	0.05	0.01	0.00	0.16	0.07	0.01	0.00	0.00
87	0.24	1.05	0.25	0.03	0.01	1.02	1.02	1.04	0.03	0.03
88	0.39	1.11	0.43	0.01	0.01	0.54	1.63	0.87	0.01	0.01
89	0.59	0.52	0.31	0.05	0.01	0.45	0.55	0.25	0.05	0.01
Standard Deviation	0.81	0.82		$\Sigma=1$	$\Sigma=1.12$	0.90	0.69		$\Sigma=1$	$\Sigma=1.06$
Covariance & Correlation Coefficient	$COV(S_K, R_T)$				r_{KT}	$COV(S_K, R_T)$				r_{KT}
	0.12				0.18	0.06				0.09

capital/technology-intensive products, such as *SITC 73*, *SITC 67*, *SITC 77*, *SITC 59*, *SITC 72*, *SITC 88*, *SITC 68*, *SITC 52*, *SITC 53*, *SITC 74*, *SITC 66*, *SITC 71*, *SITC 57*, *SITC 56* and *SITC 87*.

Consequently, Korea's promising and potential exportable products to Thailand (i.e., the products which have a high value of $S_K^h \cdot R_T^h$ in Table 8) in 2003 turn out to be (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 77*, *SITC 76*, *SITC 75*, *SITC 67*, *SITC 73*, *SITC 79*, and *SITC 72*.

In 2008, Korea's promising and potential exportable products to Thailand change to (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 77*, *SITC 73*, *SITC 67*, *SITC 76*, *SITC 72*, *SITC 79*, *SITC 75* and *SITC 87*.

As mentioned in sub-sections 3.1 to 3.4, the standard deviation of S_K^h increases in the period of 2005-2008, which means that Korea's export specialization becomes *more concentrated* over time. The standard deviation of R_T^h , however, decreases from 0.82 in 2003 to 0.69 in 2008, which means that Thailand's import specialization becomes *more diversified* over the period.

Since Korea's pattern of export specialization and Thailand's pattern of import specialization were positively correlated in 2003 (i.e., $COV(S_K, R_T) = 0.12$), C_{KT} (i.e., Korea's trade complementarity with Thailand) reached 1.12, which means that Korea's export structure and Thailand's import structure were *complementary* with each other in 2003. As this positive covariance between Korea's pattern of export specialization and Thailand's pattern of import specialization decreased to 0.06 in 2005 (i.e., $COV(S_K, R_T) = 0.06$), C_{KT} reached 1.06, which means that Korea's export structure and

Thailand's import structure became a little bit *less complementary* with each other in 2008.

Accordingly, the correlation coefficient between Korea's export specialization structure and Thailand's import specialization structure (i.e., r_{KT}), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification, decreased from 0.18 in 2003 to 0.09 in 2008. This implies that Korea's export structure and Thailand's import structure became *less complementary* with each other for the period of 2003-2008, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and Thailand's pattern of import specialization.

IV. Summary and Concluding Remarks

From the above analysis on Korea's trade intensity with major ASEAN countries, the following policy recommendation can be suggested.

(1) It was found that Korea's trade intensity with Indonesia decreased from 6.99 in 2003 to 6.74 in 2008 due to (a) the decrease in Korea's special country bias with Indonesia from 6.64 in 2003 to 6.06 in 2008 and (b) the increase in Korea's trade complementarity with Indonesia from 1.05 in 2003 to 1.11 in 2008. Therefore Korea's special country bias with Indonesia should be enhanced by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Indonesia. The FTA between

two countries might help to increase capital movements and reduce tariffs and import restrictions.

(2) It was also found that Korea's trade intensity with Malaysia increased from 3.85 in 2003 to 4.11 in 2008 due to increase in Korea's special country bias with Malaysia from 2.56 in 2003 to 2.97 in 2008 even if Korea's trade complementarity with Malaysia decreased from 1.51 in 2003 to 1.38 in 2008. Therefore Korea's special country bias with Malaysia should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Malaysia.

(3) It was found that Korea's trade intensity with Philippines increased from 4.32 in 2003 to 5.99 in 2008 due to the increase in Korea's special country bias with Philippines from 2.72 in 2003 to 4.43 in 2008 even if Korea's trade complementarity with Philippines decreased from 1.59 in 2003 to 1.35 in 2008. Therefore Korea's special country bias with Philippines should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Philippines.

(4) It was also found that Korea's trade intensity with Singapore increased from 2.94 in 2003 to 4.79 in 2008 due to the increase in Korea's special country bias with Singapore from 2.20 in 2003 to 3.94 in 2008 even if Korea's trade complementarity with Singapore decreased from 1.33 in 2003 to 1.22 in 2008. Therefore Korea's special country bias with Singapore should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Singapore.

(5) It was found that Korea's trade intensity with Thailand

increased from 2.78 in 2003 to 3.61 in 2008 due to the increase in Korea's special country bias with Thailand from 2.49 in 2003 to 3.39 in 2008 even if Korea's trade complementarity with Thailand decreased from 1.12 in 2003 to 1.06 in 2008. Therefore Korea's special country bias with Thailand should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Thailand.

(6) Korea's trade intensity with Indonesia in 2008 is the highest among her trade intensity with the five major ASEAN countries due to the fact that Korea's special country bias with Indonesia is the highest among her equivalent value with the five ASEAN countries, even if Korea's trade complementarity with Indonesia is the second lowest next to her trade intensity with Thailand. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and the other four ASEAN countries (i.e., Malaysia, Thailand, Singapore, and Philippines) do reduce Korea's special country bias with these four ASEAN countries and accordingly lessen her trade intensity with these four ASEAN countries, even if Korea's trade complementarity indices with Malaysia, Philippines, and Singapore are higher than her equivalent value with Indonesia. Therefore Korea's special country bias with these four countries should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and these four ASEAN countries.

(7) Korea's trade intensity with Philippines in 2008 is the second

highest next to her trade intensity with Indonesia. This is totally due to the fact that Korea's special country bias with Philippines is again the second highest next to her equivalent value with Indonesia, along with the fact that Korea's trade complementarity with Philippines is the second highest in the order of its value among her equivalent values with these five ASEAN countries. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and other three ASEAN countries (i.e., Malaysia, Thailand, and Singapore) do reduce Korea's special country bias with these three countries and accordingly lessen her trade intensity with these three ASEAN countries. Therefore Korea's special country bias with these three countries should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and these three ASEAN countries.

(8) Korea's trade intensity with Singapore in 2008 is the third highest next to her trade intensity with Indonesia and Philippines. This is totally due to the fact that Korea's special country bias with Singapore is the third highest next to her equivalent value with Indonesia and Philippines along with the fact that Korea's trade complementarity with Singapore is the third highest among her equivalent value with these five ASEAN countries. This means that higher transport cost, discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and Malaysia (Thailand) do reduce Korea's special country bias with

Malaysia (Thailand) and accordingly lessen her trade intensity with Thailand (Malaysia). Therefore Korea's special country bias with these two countries (i.e., Malaysia and Thailand) should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and these two ASEAN countries.

(9) Rapid wage hikes from the late 1980s in Korea forced her to lose international competitiveness in the export of labor intensive manufactured products and start to have comparative advantage in the production of manufactured commodities which are relatively capital/technology intensive such as *SITC 76*, *SITC 79*, *SITC 77*, *SITC 62*, *SITC 67*, *SITC 75*, *SITC 73*, and *SITC 87*. In order to transform Korea's export patterns more capital/technology intensive in the near future, the accumulation of physical/human capital through appropriate incentive schemes should be pursued in Korea along with the increases in R&D expenditures.

(10) Korea's promising and potential exportable products to Indonesia in the manufacturing sector in 2008 are found to be capital/technology-intensive products, such as *SITC 76*, *SITC 79*, *SITC 72*, *SITC 67*, *SITC 73*, *SITC 77*, *SITC 62*, and *SITC 56*. Therefore Korea should try to export more of these products to Indonesia from now on. Korea-Indonesia also keep increase their economic cooperation in the fields of the resource development, the refinery process and the manufacturing-related industries like fertilizer and machinery.

(11) The Korean export products in the manufacturing sector became more concentrated during the period of 2003-2008. Since this

kind of high concentration of Korean export products are not desirable for avoiding any potential economic loss associated with unfavorable trade-environmental changes against these export products, it should be relieved gradually in the near future.

(12) In 2008, Korea's promising and potential exportable products to Malaysia change to capital/technology-intensive products, such as *SITC 77*, *SITC 76*, *SITC 79*, *SITC 67*, *SITC 75*, *SITC 72*, *SITC 73*, and *SITC 87*. Therefore Korea should try to export more of these products to Malaysia from now on.

(13) Korea's promising and potential exportable products to Philippines in 2008 are found to be capital/technology-intensive products, such as *SITC 77*, *SITC 76*, *SITC 79*, *SITC 75*, *SITC 87*, *SITC 72*, *SITC 67*, and *SITC 73*. Therefore Korea should try to export more of these products to Philippines from now on.

(14) In 2008, Korea's promising and potential exportable products to Singapore change to capital/technology-intensive products, such as *SITC 79*, *SITC 77*, *SITC 76*, *SITC 75*, *SITC 72*, *SITC 87*, *SITC 88*, *SITC 73*, and *SITC 67*. Therefore Korea should try to export more of these products to Singapore from now on.

(15) Korea's promising and potential exportable products to Thailand in 2005 are found to be (a) labor-intensive product, such as *SITC 65* and (b) capital/technology-intensive products, such as *SITC 77*, *SITC 73*, *SITC 67*, *SITC 76*, *SITC 72*, *SITC 79*, *SITC 75*, and *SITC 87*. Therefore Korea should try to export more of these products to Thailand from now on.

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(2011. 08. 02. 투고; 2011. 09. 21 심사; 2011. 10. 24 게재확정)

<국문초록>

한국과 주요 ASEAN 제국간의 무역결합도 변화추이

김승진

(한국외국어대학교 국제통상학과 교수, 제1저자)

김기승

(부산대학교 경제학부 조교수, 교신저자)

Yamazawa (1970) 교수가 개발한 무역결합도 모형을 이용하여 한국의 주요 ASEAN제국에 대한 무역결합도, 무역보완도 및 국별편향도를 OECD 무역행렬자료를 이용하여 2003년과 2008년에 대해 계측하였다. 한국의 인도네시아에 대한 무역결합도는 2003년의 6.99로부터 2008년에는 6.74로 하락하였는데, 이는 한국의 인도네시아에 대한 무역보완도가 2003년의 1.05에서 2008년의 1.14로 상승하였는데도 불구하고, 한국의 인도네시아에 대한 국별편향도가 2003년의 6.64로부터 2008년에는 6.06으로 크게 하락한데 기인한 것이다. 이러한 결과는 한국의 인도네시아에 대한 무역결합도를 증진시키기 위해서는, 양국간 자본이동을 증가시키거나 무역장벽을 낮추는 등의 한국의 인도네시아에 대한 국별편향도를 상승시키는 노력이 필요하다는 것을 의미한다. 한국의 여타 주요 ASEAN제국(즉, 말레이시아, 필리핀, 싱가포르 및 태국)에 대한 무역결합도와 국별편향도는 모두 동 기간 중 상승하여, 위에서 설명한 한국의 인도네시아에 대한 무역결합도와 국별편향도와는 정 반대의 변화를 보이고

있다. 따라서 한국과 이들 여타 ASEAN제국 간에 자본이동을 증가시키거나 무역장벽을 낮춤으로써, 한국과 이들 여타 ASEAN제국 간의 국별편향도를 더욱 상승시키는 노력이 필요하다고 판단된다.

주제어: 무역결합도, 무역보완도, 국별편향도, 중력모형, 무역결합도 모형