

# Changes in Trade Intensity Between Korea and Her Major Trading Countries in the Manufacturing Sector\*

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## **Abstract**

It was found that Korea's trade intensity with the USA decreased from 2.87 in 1993 to 2.39 in 2004 due to decrease in Korea's special country bias with the USA from 3.06 in 1993 to 2.26 in 2004 even if Korea's trade complementarity with the USA increased from 0.94 in 1993 to 1.06 in 2004. Therefore Korea's special country bias with the USA should be enhanced by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and the USA.

It was also found that Korea's trade intensity with Japan decreased from 8.37 in 1993 to 8.11 in 2004 due to decrease in Korea's trade complementarity with Japan from 1.05 in 1993 to 0.88 in 2004 even if Korea's special country bias with Japan increased from 7.95 in 1993 to 9.20 in 2004. Therefore Korea's special country bias with Japan should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Japan.

It was found that Korea's trade intensity with China increased from 5.96 in 1993 to 10.39 in 2004 due to (a) increase in Korea's special country bias with China from 6.99 in 1993 to 9.58 in 2004 and (b) increase in Korea's trade complementarity with China from 0.85 in 1993 to 1.08 in 2004. Therefore Korea's special country bias with China should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and China.

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**Key Words: Trade Intensity, Trade Complementarity, Special Country Bias, Gravity Model, Trade Intensity Index Model**

**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.

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<sup>1</sup>. With the IMF bailout program along with financial assistance of other international communities, Korea could have avoided the coldest winter ever in her history of phenomenal economic development for the last four decades. Although the worst of the crisis was over as the Korean economy entered the track for recovery from mid-1998 on, numerous relating problems, such as structural reforms in the field of corporate, financial, labor and public sectors, should have been taken care of.

In August 2001 the Korean government repaid the IMF US\$ 15 billion that Korea borrowed as the IMF bailout program. Therefore Korea became free of the IMF control and Korea's international reserves as of December 2001 reached US\$ 102.8 billion. In this respect Korea completely overcame the financial crisis. The Korean economy, however, has been suffering from a long-term recession from 2003 on since the incumbent government created an anti-business sentiment and put more emphasis on distribution rather than growth.

In 2006 Korean exports to the USA rose to US\$43.2 billion (i.e., 13.3% of Korea's total exports) and Korean imports from the USA reached US\$33.7 billion (i.e., 10.9% of Korea's total imports). Consequently, Korea enjoyed US\$9.5 billion trade surplus with the USA, which accounted for 59.3% of Korean trade surplus with the whole world. Likewise, Korean exports to China in 2006 rose to US\$69.5 billion (i.e., 21.3% of Korea's total exports) and Korean imports from China reached US\$48.6 billion (i.e., 15.7% of Korea's total imports). Accordingly, Korea enjoyed US\$20.9 billion trade surplus with China, which accounted for 130.0% of Korean trade

surplus with the whole world.

On the other hand, Korean exports to Japan in 2006 rose to US\$26.5 billion (i.e., 8.2% of Korea's total exports) and Korean imports from Japan reached US\$51.9 billion (i.e., 16.8% of Korea's total imports). Consequently, Korea suffered from US\$25.4 billion trade deficit with Japan.

This paper aims to analyze how Korea's trade intensity with her major trading countries (i.e., the USA, Japan, and Korea) changed over time for the last decade (i.e., from 1993 to 2004). For this purpose, Section 2 will survey a trade intensity index model which was developed by Yamazawa (1970). Section 3 will measure a trade intensity index, a trade complementarity index, and a special country bias index between Korea and her trading countries for the last decade by using the OECD trade matrix and analyze how Korea's trade intensity with her major trading countries changed over time. Section 4 will summarize major empirical results and conclude the paper with a few remarks.

## 2. Survey on Trade Intensity Index Model

### 2.1 Trade Intensity, Trade Complementarity and Special Country Bias

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 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 model*<sup>2</sup> and the other is a *trade intensity index* model. The trade intensity index model (Yamazawa, 1970) 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

$$I_{ij} = \frac{X_{ij}}{X_i} / \frac{X_{.j}}{X_{..}} \text{-----} (1)$$

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 the GNP's of countries i and j,  $I_{ij}$  is always equal to unity<sup>3</sup>. In other words,  $I_{ij}$  equals unity if the value of trade is proportional to the GNP's 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  $\lceil$  country j's total import of the h-th commodity ( $X_{.j}^h$ )  $\rfloor$  multiplied by  $\lceil$  the share of country i in the world trade (i.e., export) of commodity h ( $X_{i.}^h / X_{..}^h$ )  $\rfloor$  as follows.

$$\bar{X}_{ij}^h = X_{.j}^h \left( \frac{X_{i.}^h}{X_{..}^h} \right) \text{-----} \quad (2)$$

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

$$\bar{X}_{ij}^h = \frac{X_{i.}^h X_{.j}^h}{X_{..}^h} \text{-----} \quad (3)$$

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

expected values of all commodities.

$$\bar{X}_{ij} = \frac{\sum_h \bar{X}_{ij}^h}{\dots} \quad (4)$$

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).

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

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

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

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.

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

which is the basic formula for our analysis.

## 2.2 Determinants of Trade Complementarity

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

$$C_{ij} = \frac{\sum_h \bar{X}_{ij}^h}{X_{i.}} / \frac{X_{.j}}{X_{..}}$$

$$\begin{aligned}
&= \sum_h \left( \frac{X_{i.}^h}{X_{i..}^h} \cdot \frac{X_{.j}^h}{X_{.j..}^h} \cdot \frac{X_{..}^h}{X_{..}^h} \right) \\
&= \sum_h \left( \frac{X_{..}^h}{X_{..}^h} \right) \cdot \left( \frac{X_{i.}^h}{X_{i..}^h} / \frac{X_{..}^h}{X_{..}^h} \right) \cdot \left( \frac{X_{.j}^h}{X_{.j..}^h} / \frac{X_{..}^h}{X_{..}^h} \right) \\
&= \sum_h \left( \frac{X_{..}^h}{X_{..}^h} \right) S_i^h \cdot R_j^h \quad \text{----- (8)}
\end{aligned}$$

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

$S_i^h$  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 specialization and country j's import specialization in commodity h respectively. Since their weighted average over all commodities always takes a constant value of unity,

$$\sum_h \left( \frac{X_{..}^h}{X_{..}^h} \right) S_i^h = \sum_h \left( \frac{X_{..}^h}{X_{..}^h} \right) R_j^h = 1 \quad \text{----- (9)}$$

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 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.

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

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<sup>4</sup>.

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

$$\begin{aligned} COV(S_i, R_j) &= \sum_h \left(\frac{X^h}{X^{..}}\right) (S_i^h - 1)(R_j^h - 1) \\ &= \sum_h \left(\frac{X^h}{X^{..}}\right) (S_i^h R_j^h - S_i^h - R_j^h + 1) \\ &= \sum_h \left(\frac{X^h}{X^{..}}\right) S_i^h R_j^h - \sum_h \left(\frac{X^h}{X^{..}}\right) S_i^h - \sum_h \left(\frac{X^h}{X^{..}}\right) R_j^h + \sum_h \left(\frac{X^h}{X^{..}}\right) \\ &= \sum_h \left(\frac{X^h}{X^{..}}\right) S_i^h R_j^h - 1 - 1 + 1^5 \\ &= \sum_h \left(\frac{X^h}{X^{..}}\right) S_i^h R_j^h - 1 \\ &= C_{ij} - 1^6 \\ \text{or } C_{ij} &= COV(S_i, R_j) + 1 \text{----- (11)} \end{aligned}$$

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<sup>7</sup>. 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.

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

### 3. Korea's Trade Intensity With Her Major Trading Countries in the Manufacturing Sector

#### 3.1 Thirty Five Industries in the Manufacturing Sector

To calculate Korea's trade intensity with her major trading countries for the last decade, 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
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*, pp. 405-406.

### 3.2 Korea's Trade Intensity, Trade Complementarity and Special Country Bias With Her Major Trading Countries

Korea's trade intensity, trade complementarity, and special country bias with her major trading countries in the manufacturing sector for the period of 1993-2004 are displayed in Table 3. The results show that Korea's trade intensity with the USA decreased from 2.87 in 1993 to 2.39 in

2004, which advocates that the USA became less important as Korea's major trading partner over the last decade. This is totally due to the following two facts. One is that Korea's trade complementarity with the USA increased from 0.94 in 1993 to 1.06 in 2004, which means that Korea's export structure and the US import structure switched from a competing relation in 1993 to a complementing relation in 2004. The other is that Korea's special country bias with the USA decreased from 3.06 in 1993 to 2.26 in 2004 due to 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 USA over the last decade.

[Table 3] Korea's Trade Intensity, Trade Complementarity, and Special Country Bias  
with USA, Japan, China in Manufacturing Sector : 2004, 1993

	<b>Year</b>	<b>U.S.A.</b>	<b>Japan</b>	<b>China</b>
<b>Trade</b>	2004	2.39	8.11	10.39
<b>Intensity</b>	1993	2.87	8.37	5.96
<b>Trade</b>	2004	1.06	0.88	1.08
<b>Complementarity</b>	1993	0.94	1.05	0.85
<b>Special Country</b>	2004	2.26	9.20	9.58
<b>Bias</b>	1993	3.06	7.95	6.99

Table 3 also tells us that Korea's trade intensity with Japan decreased from 8.37 in 1993 to 8.11 in 2004, which proves that Japan also became less important as Korea's major trading partner over the last decade. This is totally due to the following two facts. One is that Korea's trade complementarity with Japan decreased from 1.05 in 1993 to 0.88 in 2004, which means that Korea's export structure and Japan's import structure switched from a complementing relation in 1993 to a competing relation in 2004. The other is that Korea's special country bias with Japan increased from 7.95 in 1993 to 9.20 in 2004 due to the increase in Japan's FDI to Korea from US\$286.0 million in 1993 to US\$2,262.5 million in 2004.

On the other hand, China emerged as Korea's major trading partner as shown in the fact that Korea's trade intensity with China drastically increased from 5.96 in 1993 to 10.39 in 2004. This is totally due to the following two facts. One is that Korea's trade complementarity with China increased from 0.85 in 1993 to 1.08 in 2004, which means that Korea's export structure and China's import structure switched from a competing relation in 1993 to a complementing relation in 2004.

The other is that Korea's special country bias with China also increased from 6.99 in 1993 to 9.58 in 2004 due to the increase in Korea's FDI to China from US\$264.0 million in 1993 to US\$2,300.7 million in 2004.

Korea's trade intensity with the USA in 2004 is lower than her trade intensity with Japan. This is totally due to the fact that Korea's special country bias with the USA is much lower than her equivalent value with Japan, even if Korea's trade complementarity with the USA is higher than her equivalent value with Japan. 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 USA do reduce Korea's special country bias with the USA and accordingly lessen her trade intensity with the USA, even if Korea's trade complementarity with the USA is higher than her equivalent value with Japan.

Korea's trade intensity with China in 2004 is higher than her trade intensity with the USA. This is totally due to the fact that Korea's special country bias with China is much higher than her equivalent value with the USA, along with the fact that Korea's trade complementarity with China is higher than her equivalent value with the USA. This means that lower transport cost, discriminatory tariffs and other import restrictions, higher capital movements and economic cooperation which are prevalent in the economic relations between Korea and China do increase Korea's special country bias with China and accordingly raise her trade intensity with China, which is also reinforced by the fact that Korea's trade complementarity with China is higher than her equivalent value with the USA.

Korea's trade intensity with Japan in 2004 is lower than her trade intensity with China. This is totally due to the fact that Korea's special country bias with Japan is lower than her equivalent value with China, along with the fact that Korea's trade complementarity with Japan is lower than her equivalent value with China. This means that higher discriminatory tariffs and other import restrictions, lower capital movements and economic cooperation which are prevalent in the economic relations between Korea and Japan do reduce Korea's special country bias with Japan and accordingly lessen her trade intensity with Japan, which is also strengthened by the fact that Korea's trade complementarity with Japan is lower than her equivalent value with China.

### 3.3 Determinants of Korea's Trade Complementarity with the USA

As shown in Table 4, Korea in both 1993 and 2004 has comparative advantage in the

production of (a) labor-intensive products, 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), and rubber manufactures, n.e.s. (SITC 62)* (refer to Table 2 for the classification of manufactured products by factor intensity and end uses).

[Table 4] Analysis of Korea's Trade Complementarity to USA in Manufacturing Sector: 2004, 1993

SITC	2004					1993				
	$S_K^h$	$R_U^h$	$S_K^h \cdot R_U^h$	$\frac{X_{..}^h}{X_{..}}$	$\cdot S_K^h \cdot R_U^h$	$S_K^h$	$R_U^h$	$S_K^h \cdot R_U^h$	$\frac{X_{..}^h}{X_{..}}$	$\cdot S_K^h \cdot R_U^h$
51	0.36	1.02	0.37		0.01	0.46	0.80	0.37		0.01
52	0.26	0.73	0.19		0.00	0.21	0.90	0.19		0.00
53	0.36	0.51	0.18		0.00	0.27	0.51	0.14		0.00
54	0.04	0.95	0.04		0.00	0.10	0.50	0.05		0.00
55	0.11	0.76	0.09		0.00	0.07	0.42	0.03		0.00
56	0.08	0.80	0.06		0.00	0.12	1.07	0.13		0.00
57	0.67	0.59	0.40		0.01	0.40	0.40	0.16		0.00
58	0.87	0.69	0.60		0.01	0.63	0.55	0.35		0.00
59	0.30	0.71	0.21		0.00	0.14	0.55	0.08		0.00
61	0.09	0.42	0.04		0.00	0.28	0.47	0.13		0.00
62	1.44	0.93	1.34		0.01	1.71	0.92	1.58		0.02
63	0.03	1.33	0.04		0.00	0.24	0.94	0.23		0.01
64	0.40	1.02	0.42		0.01	0.14	1.02	0.14		0.00
65	1.11	0.57	0.63		0.01	1.57	0.45	0.71		0.02
66	0.26	0.75	0.20		0.00	0.39	0.84	0.33		0.01
67	0.91	0.58	0.53		0.02	1.38	0.73	1.01		0.04
68	0.25	0.80	0.20		0.00	0.11	0.96	0.11		0.00
69	0.67	0.80	0.53		0.02	1.09	0.76	0.84		0.02
71	0.33	1.44	0.47		0.02	0.17	1.37	0.24		0.01
72	0.74	1.23	0.91		0.02	0.15	0.82	0.12		0.01
73	0.88	1.20	1.06		0.01	0.17	0.93	0.16		0.00
74	0.67	0.99	0.66		0.03	0.31	0.75	0.23		0.01
75	1.58	0.67	1.06		0.07	1.65	1.44	2.38		0.13
76	3.51	1.08	3.81		0.22	2.85	1.30	3.72		0.15
77	1.82	0.91	1.65		0.15	1.90	1.06	2.02		0.18
78	1.31	1.74	2.28		0.32	0.36	1.71	0.61		0.09
79	1.46	1.25	1.82		0.04	0.44	0.64	0.28		0.01
81	0.19	0.66	0.12		0.00	0.31	0.42	0.13		0.00
82	0.09	0.96	0.09		0.00	0.31	0.91	0.28		0.00
83	0.18	0.30	0.05		0.00	12.64	0.82	10.42		0.02
84	0.63	0.44	0.27		0.01	5.71	0.48	2.74		0.07
85	0.16	0.30	0.05		0.00	7.44	0.70	5.24		0.04
87	0.36	1.26	0.45		0.01	0.25	0.91	0.22		0.01
88	0.38	1.10	0.41		0.00	0.66	1.11	0.73		0.01
89	0.48	0.80	0.38		0.02	1.37	0.86	1.18		0.06
Standard Deviation	0.83	0.38			=1.06	1.67	0.16			=0.94

Covar. & Corr. Coeff.	$COV(S_K, R_U)$ 0.06	$r_{KU}$ 0.19	$COV(S_K, R_U)$ -0.06	$r_{KU}$ -0.23
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On top of these products, Korea in 1993 used to have comparative advantage in the production of (a) capital/technology-intensive products, such as *iron and steel (SITC 67)* and (b) labor-intensive products, such as *travel goods, handbags, etc. (SITC 83)*, *footwear (SITC 85)*, *articles of apparel and clothing accessories (SITC 84)*, *miscellaneous manufactured articles, n.e.s. (SITC 89)* and *manufactures of metal, n.e.s. (SITC 69)*. In 2004 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *road vehicles (SITC 78)*, and *other transport equipments (SITC 79)*.

On the other hand, the USA has comparative disadvantage in the production of capital/technology-intensive products, such as *road vehicles (SITC 78)*, *office machines and ADP equipment (SITC 75)*, *power generating machinery and equipment (SITC 71)*, *telecommunications and sound recording apparatus (SITC 76)*, *photo apparatus, optical goods, watches and clocks (SITC 88)*, *fertilizers (SITC 56)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, and *paper and paper manufactures (SITC 64)* in 1993. In 2004, the USA continues to have comparative disadvantage in the production of (a) capital/technology-intensive products, such as *road vehicles (SITC 78)*, *power generating machinery and equipment (SITC 71)*, *professional and scientific instruments, n.e.s.(SITC 87)*, *other transport equipments (SITC 79)*, *specialized machinery (SITC 72)*, *metal working machinery (SITC 73)*, *photo apparatus, optical goods, watches and clocks (SITC 88)*, *telecommunications and sound recording apparatus (SITC 76)*, *organic chemicals (SITC 51)*, and *paper and paper manufactures (SITC 64)* and (b) labor-intensive products, such as *corks and wood manufactures (excluding furniture) (SITC 63)*.

Consequently, Korea's promising and potential exportable products to the USA (i.e., the products which have a high value of  $S_K^h \cdot R_U^h$  in Table 4) in 1993 turn out to be (a) labor-intensive product, such as *travel goods, handbags, etc. (SITC 83)*, *footwear (SITC 85)*, *articles of apparel and clothing accessories (SITC 84)*, and *miscellaneous manufactured articles, n.e.s. (SITC 89)* 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 *iron and steel (SITC 67)*. In 2004, Korea's promising and potential exportable products to the USA

changes to capital/technology-intensive products, such as *telecommunications and sound recording apparatus (SITC 76)*, *road vehicles (SITC 78)*, *other transport equipments (SITC 79)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *rubber manufactures, n.e.s. (SITC 62)*, *metal working machinery (SITC 73)*, and *office machines and ADP equipment (SITC 75)*.

The standard deviation of  $S_K^h$  decreases in the period of 1993-2004, which means that Korea's export specialization becomes more diversified over time. The standard deviation of  $R_U^h$ , however, increases in the period of 1993-2004, which means that the US import specialization becomes more concentrated over time.

Since Korea's pattern of export specialization and the US pattern of import specialization were negatively correlated in 1993 (i.e.,  $COV(S_K, R_U) = -0.06$ ),  $C_{KU}$  (i.e., Korea's trade complementarity to the USA) reached 0.94, which means that Korea's export structure and the US import structure were in a competition with each other in 1993. As this negative correlation coefficient between Korea's pattern of export specialization and the US pattern of import specialization switched to a positive value in 2004 (i.e.,  $COV(S_K, R_U) = 0.06$ ),  $C_{KU}$  reached 1.06, which means that Korea's export structure and the US import structure became complementary with each other in 2004. Accordingly, the correlation coefficient between Korea's export specialization structure and the US import specialization structure (i.e.,  $r_{KU}$ ), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification increased from -0.23 in 1993 to 0.19 in 2004. This implies that Korea's export structure and the US import structure switched from a competing relation to a complementary relation with each other for the period of 1993-2004, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and the US pattern of import specialization.

### 3.4 Determinants of Korea's Trade Complementarity with Japan

As shown in Tables 4 and 5, Korea in both 1993 and 2004 has comparative advantage in the production of (a) labor-intensive products, 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)*, and *rubber manufactures, n.e.s. (SITC 62)*.

[Table 5] Analysis of Korea's Trade Complementarity to Japan in Manufacturing Sector: 2004, 1993

	2004				1993					
<i>SITC</i>	$S_K^h$	$R_J^h$	$S_K^h \cdot R_J^h$	$\frac{X_{..}^h}{X_{..}}$	$S_K^h$	$R_J^h$	$S_K^h \cdot R_J^h$	$\frac{X_{..}^h}{X_{..}}$	$S_K^h \cdot R_J^h$	
51	0.36	1.75	0.63	0.02	0.46	2.26	1.04	0.03	0.03	
52	0.26	2.58	0.67	0.01	0.21	3.50	0.74	0.01	0.01	
53	0.36	0.87	0.31	0.00	0.27	0.89	0.24	0.00	0.00	
54	0.04	1.19	0.05	0.00	0.10	2.41	0.24	0.01	0.01	
55	0.11	1.41	0.16	0.00	0.07	1.14	0.08	0.00	0.00	
56	0.08	0.73	0.06	0.00	0.12	1.26	0.15	0.00	0.00	
57	0.67	0.85	0.57	0.01	0.40	0.69	0.28	0.01	0.01	
58	0.87	0.79	0.68	0.01	0.63	0.52	0.33	0.00	0.00	
59	0.30	1.89	0.57	0.01	0.14	1.52	0.21	0.00	0.00	
61	0.09	0.58	0.05	0.00	0.28	1.48	0.42	0.00	0.00	
62	1.44	0.49	0.70	0.01	1.71	0.81	1.39	0.02	0.02	
63	0.03	0.84	0.02	0.00	0.24	1.06	0.26	0.00	0.00	
64	0.40	0.68	0.28	0.01	0.14	0.70	0.10	0.00	0.00	
65	1.11	0.56	0.62	0.01	1.57	0.61	0.97	0.03	0.03	
66	0.26	0.74	0.19	0.00	0.39	1.00	0.39	0.01	0.01	
67	0.91	0.52	0.48	0.02	1.38	0.23	0.30	0.01	0.01	
68	0.25	1.51	0.37	0.01	0.11	1.97	0.22	0.01	0.01	
69	0.67	0.69	0.46	0.01	1.09	0.50	0.54	0.02	0.02	
71	0.33	0.90	0.29	0.01	0.17	0.57	0.10	0.00	0.00	
72	0.74	1.24	0.92	0.03	0.15	0.74	0.11	0.01	0.01	
73	0.88	1.68	1.48	0.01	0.17	0.76	0.13	0.00	0.00	
74	0.67	0.92	0.61	0.03	0.31	0.59	0.18	0.01	0.01	
75	1.58	0.72	1.13	0.08	1.65	1.32	2.19	0.12	0.12	
76	3.51	0.60	2.09	0.12	2.85	0.59	1.68	0.07	0.07	
77	1.82	1.20	2.19	0.20	1.90	0.70	1.33	0.12	0.12	
78	1.31	0.64	0.84	0.12	0.36	0.74	0.27	0.04	0.04	
79	1.46	2.17	3.17	0.08	0.44	1.37	0.60	0.03	0.03	
81	0.19	0.59	0.11	0.00	0.31	0.52	0.16	0.00	0.00	
82	0.09	0.51	0.05	0.00	0.31	0.49	0.15	0.00	0.00	
83	0.18	3.05	0.54	0.00	12.64	6.48	81.87	0.13	0.13	
84	0.63	0.50	0.32	0.01	5.71	1.35	7.69	0.20	0.20	
85	0.16	0.45	0.07	0.00	7.44	0.98	7.28	0.05	0.05	
87	0.36	2.52	0.92	0.02	0.25	1.89	0.46	0.01	0.01	
88	0.38	2.23	0.84	0.01	0.66	1.40	0.92	0.02	0.02	
89	0.48	1.13	0.54	0.03	1.37	1.46	2.00	0.10	0.10	
Standard Deviation	0.83	0.52		=0.88	1.67	0.35		=1.05		
Covar. & Corr. Coeff.	$COV(S_K, R_J)$			$r_{KJ}$	$COV(S_K, R_J)$			$r_{KJ}$		
	-0.12			-0.27	0.05			0.09		

On top of these products, Korea in 1993 used to have comparative advantage in the production of (a) capital/technology-intensive products, such as *iron and steel (SITC 67)* and (b) labor-intensive products, such as *travel goods, handbags, etc. (SITC 83)*, *footwear (SITC 85)*,

*articles of apparel and clothing accessories (SITC 84), miscellaneous manufactured articles, n.e.s. (SITC 89) and manufactures of metal, n.e.s. (SITC 69).* In 2004 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *road vehicles (SITC 78), and other transport equipments (SITC 79).*

On the other hand, Japan has comparative disadvantage in the production of labor-intensive products, such as *travel goods, handbags, etc. (SITC 83), leather, leather manufactures and dressed furskins (SITC 61), miscellaneous manufactured articles, n.e.s. (SITC 89), articles of apparel and clothing accessories (SITC 84), cork and wood manufactures (excluding furniture) (SITC 63), and non-metallic mineral manufactures, n.e.s. (SITC 66)* in 1993. On top of that, Japan also has comparative disadvantage in the production of capital/technology-intensive products, such as *inorganic chemicals (SITC 52), medicinal and pharmaceutical products (SITC 54), organic chemicals (SITC 51), non-ferrous metals (SITC 68), professional and scientific instruments, n.e.s. (SITC 87), chemical materials and products, n.e.s. (SITC 59), photo apparatus, optical goods, watches and clocks (SITC 88), other transport equipments (SITC 79), office machines and ADP equipment (SITC 75), fertilizers (SITC 56), and essential oils and perfume materials (SITC 55)* in 1993.

In 2004, Japan continues to have comparative disadvantage in the production of (a) capital/technology-intensive products, such as *inorganic chemicals (SITC 52), professional and scientific instruments, n.e.s. (SITC 87), photo apparatus, optical goods, watches and clocks (SITC 88), other transport equipments (SITC 79), chemical materials and products, n.e.s. (SITC 59), organic chemicals (SITC 51), metal working machinery (SITC 73), non-ferrous metals (SITC 68), essential oils and perfume materials (SITC 55), specialized machinery (SITC 72), electrical machinery, apparatus and appliances, n.e.s. (SITC 77), and medicinal and pharmaceutical products (SITC 54)* and (b) labor-intensive products, such as *travel goods, handbags, etc. (SITC 83) and miscellaneous manufactured articles, n.e.s. (SITC 89).*

Consequently, Korea's promising and potential exportable products to Japan (i.e., the products which have a high value of  $S_K^h \cdot R_J^h$  in Table 5) in 1993 turn out to be (a) labor-intensive product, such as *travel goods, handbags, etc. (SITC 83), articles of apparel and clothing accessories (SITC 84), footwear (SITC 85), and miscellaneous manufactured articles, n.e.s. (SITC 89)* and (b) capital/technology-intensive products, such as *office machines and ADP equipment (SITC 75), telecommunications and sound recording apparatus (SITC 76), rubber manufactures, n.e.s. (SITC 62), electrical machinery, apparatus and appliances, n.e.s. (SITC 77), and organic*



*chemicals (SITC 51)*. In 2004, Korea's promising and potential exportable products to Japan changes to capital/technology-intensive products, such as *other transport equipments (SITC 79)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *telecommunications and sound recording apparatus (SITC 76)*, *metal working machinery (SITC 73)*, and *office machines and ADP equipment (SITC 75)*.

As mentioned in sub-section 3.3, the standard deviation of  $S_K^h$  decreases in the period of 1993-2004, which means that Korea's export specialization becomes more diversified over time. The standard deviation of  $R_J^h$ , however, increases in the period of 1993-2004, which means that Japan's import specialization becomes more concentrated over time.

Since Korea's pattern of export specialization and Japan's pattern of import specialization were positively correlated in 1993 (i.e.,  $COV(S_K, R_J) = 0.05$ ),  $C_{KJ}$  (i.e., Korea's trade complementarity to Japan) reached 1.05, which means that Korea's export structure and Japan's import structure were complementary with each other in 1993. As this positive correlation coefficient between Korea's pattern of export specialization and Japan's pattern of import specialization switched to a negative value in 2004 (i.e.,  $COV(S_K, R_J) = -0.12$ ),  $C_{KJ}$  reached 0.88, which means that Korea's export structure and Japan's import structure became in a competition with each other in 2004. Accordingly, the correlation coefficient between Korea's export specialization structure and Japan's import specialization structure (i.e.,  $r_{KJ}$ ), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification decreased from 0.09 in 1993 to -0.27 in 2004. This implies that Korea's export structure and Japan's import structure switched from a complementary relation to a competing relation with each other for the period of 1993-2004, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and Japan's pattern of import specialization.

### 3.5 Determinants of Korea's Trade Complementarity with China

As shown in Tables 4 to 6, Korea in both 1993 and 2004 has comparative advantage in the production of (a) labor-intensive products, 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)*, and *rubber manufactures, n.e.s. (SITC 62)*.

[Table 6] Analysis of Korea's Trade Complementarity to China in Manufacturing Sector: 2004, 1993

<i>SITC</i>	2004				1993			
	$S_K^h$	$R_C^h$	$S_K^h \cdot R_C^h$	$\frac{X_{..}^h}{X_{..}} \cdot S_K^h \cdot R_C^h$	$S_K^h$	$R_C^h$	$S_K^h \cdot R_C^h$	$\frac{X_{..}^h}{X_{..}} \cdot S_K^h \cdot R_C^h$
51	0.36	1.86	0.67	0.02	0.46	0.73	0.34	0.01
52	0.26	0.64	0.17	0.00	0.21	0.21	0.45	0.00
53	0.36	1.22	0.44	0.00	0.27	0.40	0.11	0.00
54	0.04	0.14	0.01	0.00	0.10	0.31	0.03	0.00
55	0.11	0.33	0.04	0.00	0.07	0.17	0.01	0.00
56	0.08	1.05	0.08	0.00	0.12	3.68	0.44	0.00
57	0.67	2.22	1.49	0.03	0.40	0.79	0.32	0.01
58	0.87	1.02	0.89	0.01	0.63	0.27	0.17	0.00
59	0.30	0.98	0.29	0.00	0.14	0.41	0.06	0.00
61	0.09	2.04	0.19	0.00	0.28	0.79	0.22	0.00
62	1.44	0.33	0.47	0.01	1.71	0.17	0.29	0.00
63	0.03	0.19	0.01	0.00	0.24	0.08	0.02	0.00
64	0.40	0.53	0.21	0.00	0.14	0.34	0.05	0.00
65	1.11	1.42	1.58	0.04	1.57	0.97	1.53	0.05
66	0.26	0.52	0.14	0.00	0.39	0.25	0.10	0.00
67	0.91	1.55	1.41	0.05	1.38	3.58	4.92	0.18
68	0.25	0.92	0.23	0.00	0.11	0.45	0.05	0.00
69	0.67	0.56	0.37	0.01	1.09	0.42	0.46	0.01
71	0.33	1.11	0.36	0.01	0.17	1.23	0.21	0.01
72	0.74	3.50	2.58	0.07	0.15	2.97	0.44	0.02
73	0.88	4.42	3.88	0.03	0.17	4.05	0.70	0.01
74	0.67	1.52	1.01	0.05	0.31	1.47	0.46	0.03
75	1.58	0.83	1.31	0.09	1.65	0.26	0.44	0.02
76	3.51	1.03	3.63	0.21	2.85	2.45	6.98	0.27
77	1.82	1.74	3.17	0.29	1.90	0.56	1.07	0.10
78	1.31	0.40	0.53	0.07	0.36	0.72	0.26	0.04
79	1.46	1.21	1.77	0.04	0.44	1.74	0.77	0.03
81	0.19	0.17	0.03	0.00	0.31	0.37	0.11	0.00
82	0.09	0.18	0.02	0.00	0.31	0.09	0.03	0.00
83	0.18	0.04	0.01	0.00	12.64	0.05	0.63	0.00
84	0.63	0.05	0.03	0.00	5.71	0.10	0.59	0.02
85	0.16	0.15	0.02	0.00	7.44	0.04	0.27	0.00
87	0.36	1.79	0.65	0.02	0.25	0.93	0.23	0.01
88	0.38	1.61	0.60	0.01	0.66	0.34	0.23	0.00
89	0.48	0.32	0.15	0.01	1.37	0.28	0.39	0.02
Standard Deviation	0.83	0.78		=1.08	1.67	0.91		=0.85
Covar. & Corr. Coeff.	$COV(S_K, R_C)$			$r_{KC}$	$COV(S_K, R_C)$			$r_{KC}$
	0.08			0.13	-0.15			-0.10

On top of these products, Korea in 1993 used to have comparative advantage in the production of (a) capital/technology-intensive products, such as *iron and steel (SITC 67)* and (b)

labor-intensive products, such as *travel goods, handbags, etc. (SITC 83)*, *footwear (SITC 85)*, *articles of apparel and clothing accessories (SITC 84)*, *miscellaneous manufactured articles, n.e.s. (SITC 89)* and *manufactures of metal, n.e.s. (SITC 69)*. In 2004 Korea additionally gains comparative advantage in the production of capital/technology-intensive products, such as *road vehicles (SITC 78)*, and *other transport equipments (SITC 79)*.

On the other hand, China has comparative disadvantage in the production of capital/technology-intensive products, such as *metal working machinery (SITC 73)*, *fertilizers (SITC 56)*, *iron and steel (SITC 67)*, *specialized machinery (SITC 72)*, *telecommunications and sound recording apparatus (SITC 76)*, *other transport equipments (SITC 79)*, *other industrial machinery and parts (SITC 74)*, *power generating machinery and equipment (SITC 71)* in 1993. In 2004, China continues to have comparative disadvantage in the production of (a) capital/technology-intensive products, such as *metal working machinery (SITC 73)*, *specialized machinery (SITC 72)*, *plastics in primary forms (SITC 57)*, *organic chemicals (SITC 51)*, *professional and scientific instruments, n.e.s. (SITC 87)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *photo apparatus, optical goods, watches and clocks (SITC 88)*, *iron and steel (SITC 67)*, *other industrial machinery and parts (SITC 74)*, *dyeing, tanning and coloring materials (SITC 53)*, *other transport equipments (SITC 79)*, *power generating machinery and equipment (SITC 71)*, *fertilizers (SITC 56)*, *telecommunications and sound recording apparatus (SITC 76)*, and *plastics in non-primary forms (SITC 58)* and (b) labor-intensive products such as *leather, leather manufactures and dressed furskins (SITC 61)* and *textile yarn, fabrics and related products (SITC 65)*.

Consequently, Korea's promising and potential exportable products to China (i.e., the products which have a high value of  $S_K^h \cdot R_C^h$  in Table 6) in 1993 turn out to be (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)*, *iron and steel (SITC 67)*, and *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*. In 2004, Korea's promising and potential exportable products to China changes to (a) labor-intensive product, such as *textile yarn, fabrics and related products (SITC 65)* and (b) capital/technology-intensive products, such as *metal working machinery (SITC 73)*, *telecommunications and sound recording apparatus (SITC 76)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *specialized machinery (SITC 72)*, *other transport equipments (SITC 79)*, *plastics in primary forms (SITC 57)*, *iron and steel (SITC 67)*, *office*

*machines and ADP equipment (SITC 75), and other industrial machinery and parts (SITC 74).*

As mentioned in sub-sections 3.3 and 3.4, the standard deviation of  $S_K^h$  decreases in the period of 1993-2004, which means that Korea's export specialization becomes more diversified over time. The standard deviation of  $R_C^h$  also decreases in the period of 1993-2004, which means that China's import specialization becomes more diversified over time.

Since Korea's pattern of export specialization and China's pattern of import specialization were negatively correlated in 1993 (i.e.,  $COV(S_K, R_C) = -0.15$ ),  $C_{KC}$  (i.e., Korea's trade complementarity to China) reached 0.85, which means that Korea's export structure and China's import structure were in a competition with each other in 1993. As this negative correlation coefficient between Korea's pattern of export specialization and China's pattern of import specialization switched to a positive value in 2004 (i.e.,  $COV(S_K, R_C) = 0.08$ ),  $C_{KC}$  reached 1.08, which means that Korea's export structure and China's import structure became complementary with each other in 2004. Accordingly, the correlation coefficient between Korea's export specialization structure and China's import specialization structure (i.e.,  $r_{KC}$ ), which is the measure of the degree of match of the two patterns neutral from the degree of concentration or diversification increased from -0.10 in 1993 to 0.13 in 2004. This implies that Korea's export structure and China's import structure switched from a competing relation to a complementary relation with each other for the period of 1993-2004, if the degree of concentration or diversification was deleted from Korea's pattern of export specialization and China's pattern of import specialization.

#### **4. Summary and Concluding Remarks**

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

Firstly, it was found that Korea's trade intensity with the USA decreased from 2.87 in 1993 to 2.39 in 2004 due to decrease in Korea's special country bias with the USA from 3.06 in 1993 to 2.26 in 2004 even if Korea's trade complementarity with the USA increased from 0.94 in 1993 to 1.06 in 2004. Therefore Korea's special country bias with the USA should be enhanced by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and the USA.

Secondly, it was also found that Korea's trade intensity with Japan decreased from 8.37 in

1993 to 8.11 in 2004 due to decrease in Korea's trade complementarity with Japan from 1.05 in 1993 to 0.88 in 2004 even if Korea's special country bias with Japan increased from 7.95 in 1993 to 9.20 in 2004. Therefore Korea's special country bias with Japan should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and Japan.

Thirdly, it was found that Korea's trade intensity with China increased from 5.96 in 1993 to 10.39 in 2004 due to (a) increase in Korea's special country bias with China from 6.99 in 1993 to 9.58 in 2004 and (b) increase in Korea's trade complementarity with China from 0.85 in 1993 to 1.08 in 2004. Therefore Korea's special country bias with China should be enhanced further by increasing capital movements and reducing discriminatory tariffs and other import restrictions between Korea and China.

Fourthly, Korea's trade intensity with the USA in 2004 is found to be lower than her trade intensity with Japan due to the fact that Korea's special country bias with the USA is much lower than her equivalent value with Japan even if Korea's trade complementarity with the USA is higher than her equivalent value with Japan. Therefore the higher transport costs, higher discriminatory tariffs and other import restrictions which are prevalent in the economic relations between Korea and the USA should gradually be reduced. Furthermore, capital movements and economic cooperation between Korea and the USA should be facilitated to increase Korea's special country bias with the USA and accordingly enhance her trade intensity with the USA.

Fifthly, Korea's trade intensity with China in 2004 is found to be higher than her trade intensity with the USA due to the following two facts: (a) Korea's special country bias with China is much higher than her equivalent value with the USA and (b) Korea's trade complementarity with China is higher than her equivalent value with the USA. Therefore special measures should be pursued in order to enhance Korea's special country bias with the USA by adopting the same strategy as listed in the above paragraph.

Sixthly, Korea's trade intensity with Japan in 2004 is found to be lower than her trade intensity with China due to the following two facts: (a) Korea's special country bias with Japan is lower than her equivalent value with China (b) Korea's trade complementarity with Japan is lower than her equivalent value with China. Therefore the higher discriminatory tariffs and other import restrictions which are prevalent in the economic relations between Korea and Japan should gradually be reduced. Furthermore, capital movements and economic cooperation between Korea and Japan should be facilitated to increase Korea's special country bias with Japan and accordingly

enhance her trade intensity with Japan.

Seventhly, 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 *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)*, *iron and steel (SITC 67)*, *road vehicles (SITC 78)*, and *other transport equipments (SITC 79)*. 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.

Eighthly, Korea's promising and potential exportable products to the USA in the manufacturing sector in 2004 are found to be capital/technology-intensive products, such as *telecommunications and sound recording apparatus (SITC 76)*, *road vehicles (SITC 78)*, *other transport equipments (SITC 79)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *rubber manufactures, n.e.s. (SITC 62)*, *metal working machinery (SITC 73)*, and *office machines and ADP equipment (SITC 75)*. Therefore Korea should try to export more of these products to the USA from now on.

Ninthly, the Korean export products in the manufacturing sector became more diversified during the period of 1993-2004. Since this kind of high diversification of Korean export products are desirable for avoiding any potential economic loss associated with unfavorable trade-environmental changes against these export products, it should be facilitated even further.

Tenthly, Korea's promising and potential exportable products to Japan in the manufacturing sector in 2004 turn out to be capital/technology-intensive products, such as *other transport equipments (SITC 79)*, *electrical machinery, apparatus and appliances, n.e.s. (SITC 77)*, *telecommunications and sound recording apparatus (SITC 76)*, *metal working machinery (SITC 73)*, and *office machines and ADP equipment (SITC 75)*. Therefore Korea should try to export more of these products to Japan from now on.

Eleventhly, Korea's promising and potential exportable products to China in the manufacturing sector in 2004 are found to be (a) labor-intensive product, such as *textile yarn, fabrics and related products (SITC 65)* and (b) capital/technology-intensive products, such as *metal working machinery (SITC 73)*, *telecommunications and sound recording apparatus (SITC 76)*,

*electrical machinery, apparatus and appliances, n.e.s. (SITC 77), specialized machinery (SITC 72), other transport equipments (SITC 79), plastics in primary forms (SITC 57), iron and steel (SITC 67), office machines and ADP equipment (SITC 75), and other industrial machinery and parts (SITC 74).* Therefore Korea should try to export more of these products to China from now on.

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<sup>1</sup> This was totally due to her consistent current account deficit since 1994 and a sharp fall in the rollover ratio of short-term external borrowings by domestic financial institutions.

<sup>2</sup> 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  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  be positive constants.

<sup>3</sup> Refer to footnote 4 in p 62 in Yamazawa (1970).

<sup>4</sup> Refer to pp. 65-66 in Yamazawa (1970).

<sup>5</sup> According to Equation (9),  $\sum_h \left( \frac{X_{..}^h}{X_{..}} \right) S_i^h = \sum_h \left( \frac{X_{..}^h}{X_{..}} \right) R_j^h = 1$ .

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

<sup>6</sup> By Equation (8).

<sup>7</sup> Refer to the example of Table 1 in p 66 in Yamazawa (1970).