

## Trade Structures and Relations among China, Japan, and Korea<sup>\*</sup>

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This paper analyzes trade structures and relations among the three countries in Northeast Asia, China, Japan, and Korea to show that they are very trade dependent on each other with important inter-industry and intra-industry trade. Some major features of trade among the countries (such as trade balances and trade in agricultural products) are investigated.

China, Japan, and Korea in Northeast Asia have been very trade-dependent on each other. Together they form a huge economic unit. In terms of the stages of economic development, Japan has the most advanced economy, and China has the least developed one. Korea, both in terms of geographical location and economic development, is the middle one. It is therefore important to study the features of trade among these economies to analyze the prospect of economic integration.

It is first noted that the export structures are becoming similar. Second, as the export structures of these three countries are becoming similar competition in the world market is also becoming more intense. Looking at the trade specialization indices (*TSI*), the export similarity indices (*ESI*), and changes in the US market share of these countries from 2000 to 2005, it is found that competition in particular between Korea and China and between China and Japan intensified. Results point out that Korea and Japan is facing

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considerable pressure from Chinese growth that is catching up to the former.

Results show that Korea and Japan face more than rivalry and competition from China. There is much complementarity between the exports of these countries because the three economies are in different stages of development, and many of the industries (especially manufacturing industries) show vertical differentiation. The results indicate high degrees of intra-industry trade, and that the intra-regional trade shares have been steadily rising in the past several years. They also have high intra-industry trade (*IIT*) indices. The IIT among three countries showed high degree of correlation with each other.

JEL Classification: F14, O53

Keywords: intra-industry trade, inter-industry trade, trade specialization index, export similarity index, complementarity

## 1. INTRODUCTION

Northeast Asia is drawing increasing attention from the international community. China has the fastest growing economy with even greater potential in the future. Japan has the second largest global economy with massive capital and advanced technology. Korea, quickly recovered from a 1997 economic crisis, has the most dynamic economy with superior Information Communication Technology. China, Japan, and Korea produce one fifth of the global GDP and form a major economic region. Despite differences in the political and economic systems in the region and a past history of conflict, economic interdependence among the three countries is substantially deepening.

Economic interdependence among these three countries takes many different forms: foreign trade, foreign direct investment, and portfolio investment. This paper examines the changing pattern of economic interdependence among the three countries via foreign trade. China, Japan,

and Korea have expanded trade in taking advantage of the complementarity form of industrial structures, together with geographical proximity. Competitive relations among them have also intensified, as industrial structures became increasingly similar in the recent years. This phenomenon is taking place, as Korea and China respectively catch up with Japan and Korea.

It is valuable to analyze the recent changing pattern of trade relations among China, Japan, and Korea. This paper analyzes trade structures of and trade relations among the three countries in Northeast Asia, Korea, China, and Japan to show that they are very trade dependent on each other, with important inter-industry and intra-industry trade. Major features of trade among the countries, such as trade balances and trade in agricultural products are carefully investigated. Such discussion may shed light on the proposed FTAs consisting of two or three of the countries.

## **2. TRADE STRUCTURES OF CHINA, JAPAN, AND KOREA**

Table 1 presents the export and import trends of China, Japan, and Korea. The total exports of three countries have increased from US\$854,231 million in 2000 to US\$1,596,800 million in 2005, and the total imports increased from US\$728,530 million to US\$1,397,977 million dollars during the same period. The import and export of these countries grew faster than those of the world, as the share of the total export of these countries increased from 13.4% in 2000 to 15.4% in 2005, and the corresponding increase in the import share was from 11% to 12.9%. The main reason for the increases is mainly due to the growing significance of China's foreign trade.<sup>1)</sup> It accounts for 7.4% and 6.1% in 2005, respectively.

Table 2 shows the rising intra-regional trade among these three countries.

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<sup>1)</sup> The export and import shares of China in the world market have increased by about 100% from 2000 to 2005, while they have been stable for Korea and they have decreased slightly for Japan.

**Table 1 Export and Import of China, Japan, and Korea, 2000-2005**

(unit: million US dollar, %)

		2000	2001	2002	2003	2004	2005
Export	Japan	432,723.00 (6.8)	410,314.50 (6.7)	436,533.10 (6.8)	456,968.70 (6.1)	512,541.10 (5.6)	550,054.30 (5.3)
	China	249,240.00 (3.9)	266,661.00 (4.3)	325,642.00 (5.1)	438,473.00 (5.8)	593,647.00 (6.5)	762,327.00 (7.4)
	Korea	172,268 (2.7)	150,439 (2.4)	162,471 (2.5)	193,817 (2.6)	253,845 (2.8)	284,419 (2.7)
	Total	854,231 (13.4)	827,415 (13.4)	924,646 (14.4)	1,089,259 (14.5)	1,360,033 (14.9)	1,596,800 (15.4)
	Import	Japan	342,954.00 (5.2)	355,328.20 (5.6)	353,753.10 (5.3)	371,634.60 (4.8)	411,959.80 (4.3)
	China	225,095.00 (3.4)	243,567.00 (3.8)	295,303.00 (4.4)	413,096.00 (5.3)	560,811.00 (5.9)	660,222.00 (6.1)
	Korea	160,481 (2.4)	141,098 (2.2)	152,126 (2.3)	178,827 (2.3)	224,463 (2.4)	261,238 (2.4)
	Total	728,530 (11)	739,993 (11.6)	801,182 (12)	963,558 (12.4)	1,197,234 (12.6)	1,397,977 (12.9)

Note: Numbers in parentheses represent the shares of exports (imports) in the world exports (imports).

Source: Korea International Trade Association, KOTIS data.

**Table 2 Trilateral Trade among Korea, China, and Japan, 2000-2005**

(units: million US dollar, %)

		2000	2001	2002	2003	2004	2005
Korea to (from) China	Export (A)	18,455	18,190	23,754	35,110	49,763	61,915
	Import (B)	12,799	13,303	17,400	21,909	29,585	38,648
	A-B	5,656	4,887	6,354	13,201	20,178	23,267
Korea to (from) Japan	Export (A)	20,466	16,506	15,143	17,276	21,701	24,027
	Import (B)	31,828	26,633	29,856	36,313	46,144	48,403
	A-B	-11,362	-10,127	-14,713	-19,037	-24,443	-24,376
China to (from) Japan	Export (A)	41,611	45,078	48,483	59,454	73,536	84,097
	Import (B)	41,520	42,810	53,489	74,204	94,192	100,468
	A-B	91	2,268	-5,006	-14,750	-20,656	-16,371
Intra-regional Trade Share	Export	19.5	19.6	20.3	22.4	23.2	22.4
	Import	22.9	22.0	23.5	25.4	26.3	25.6

Source: Korea International Trade Association, KOTIS Data.

Trade has increased substantially and the shares of exports and imports reached 22.4% and 25.6%, respectively in 2005. This shows that Korea, China, and Japan are very important trading partners. Given the deepening economic interdependency among the three countries, the need for policy cooperation among them is obvious.<sup>2)</sup>

One of notable findings from the trilateral trade is that trade between Korea and China has increased remarkably. In particular, Korean exports to China have increased by more than 300% during the past five years, thanks to the rapid economic growth of China, and reached US\$61,915 million in 2005. The Korean export volume to China exceeded that of Japan in 2001, and exceeded that to the US in 2003, making China the biggest export market for Korea. Korean imports from China have rapidly increased since 2000 and reached US\$38,648 million in 2005, while Korea still had a huge trade surplus with China.

Principal exports to China by Korea in 2005 consisted of HS85 (electrical machinery and equipment), HS84 (nuclear reactors, boilers, machinery and mechanic), HS29 (organic chemicals), HS90 (Optical, photographic, cinematographic), while the Chinese main exports to Korea were HS85 (electrical machinery and equipment), HS84 (nuclear reactors, boilers, machinery and mechanic), HS72 (Iron and steel). Six of the ten principal Korean exports to China and six of the ten principal Chinese exports to Korea were the same. Table 3 summarizes ten major export and import products between Korea and China for 2000 and 2005.

Japan is the largest importer and the third largest exporter for Korea. Japanese shares have gradually decreased since the 1990s in the total external trade of Korea. However, Korean shares have remained fairly stable in the total external trade of Japan.

It is interesting to note that Korea has been running enormous trade deficits with Japan that are one of the largest sources of Japanese trade surpluses.

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<sup>2)</sup> However, the shares of intra-regional trade among these three countries remain small compared to other regional economic entities. According to Lee (2002), the intra-regional shares of NAFTA were 46.5% in 1999.

**Table 3 Ten Major Export and Import Products between Korea and China, 2000 and 2005**

(unit: %)

Export to China				Import from China			
2000		2005		2000		2005	
Product	Share	Product	Share	Product	Share	Product	Share
HS85	18.6	HS85	27.2	HS85	21.1	HS85	25.0
HS84	11.0	HS84	15.7	HS27	9.0	HS84	12.2
HS39	10.3	HS29	9.7	HS84	8.2	HS72	10.4
HS29	10.2	HS90	8.6	HS72	5.9	HS27	6.1
HS27	10.1	HS39	7.4	HS10	5.5	HS62	3.8
HS72	6.5	HS72	6.2	HS62	4.4	HS76	2.8
HS41	4.1	HS27	5.4	HS3	3.7	HS73	2.3
HS54	3.6	HS87	5.2	HS55	3.2	HS90	2.3
HS55	2.8	HS74	1.6	HS90	2.4	HS29	2.2
HS59	2.5	HS54	1.0	HS52	2.4	HS10	2.2

Source: Korea International Trade Association, KOTIS Data.

The trade deficit dropped sharply to US\$11,362 million in 2000, but rose to US\$24,367 million in 2005, mainly because of the economic recovery in Korea. The domestic production in Korea depends heavily upon Japan for parts, intermediate goods, and equipment in various industries.<sup>3)</sup> This phenomenon is one of the major factors to exacerbate the Korean trade deficit with Japan. In 2005 the principal Korean exports to Japan were HS85 (electrical machinery and equipment), HS27 (mineral fuels, mineral oils), HS84 (nuclear reactors, boilers, machinery and mechanic), HS72 (iron and steel). The main exports of Japan to Korea were HS85 (electrical machinery and equipment), HS84 (nuclear reactors, boilers, machinery and mechanic), HS72 (iron and steel), HS90 (optical, photographic, cinematographic, measuring, medical or surgical instruments). Of the ten principal Korean

<sup>3)</sup> A division of labor by product differentiation and by manufacturing process exists between the two countries. The division of labor by manufacturing process is characterized by a trade pattern whereby the materials and capital goods needed for production are imported from Japan and final products are re-exported to Japan (Lee, 2002).

**Table 4 Ten Major Trading Products between Korea and Japan, 2000 and 2005**

(unit: %)

Export to Japan				Import from Japan			
2000		2005		2000		2005	
Product	Share	Product	Share	Product	Share	Product	Share
HS85	22.4	HS85	22.3	HS85	31.2	HS85	26.6
HS27	18.0	HS27	15.6	HS84	20.6	HS84	18.6
HS84	17.0	HS84	11.7	HS90	43.6	HS72	12.7
HS72	5.7	HS72	9.0	HS72	8.3	HS90	10.4
HS3	4.1	HS90	8.2	HS29	4.9	HS29	4.7
HS61	3.4	HS39	4.2	HS39	3.6	HS39	4.7
HS39	3.4	HS29	3.7	HS38	2.5	HS38	2.8
HS29	2.0	HS73	3.2	HS87	2.1	HS87	2.2
HS73	2.0	HS3	2.2	HS74	1.4	HS70	1.6
HS90	1.3	HS87	1.6	HS34	1.3	HS37	1.4

Source: Korea International Trade Association, KOTIS Data.

exports to Japan and the ten principal exports of Japan to Korea five coincided in 2000, but seven products did in 2005, even though principal Japanese export products to Korea did not change from 2000 to 2005. This may reflect the changes in the trade structures between Korea and Japan. However, it should be noted that Korean exports to Japan are mainly general purpose products, technically standardized products, and low-priced products, while Japanese exports to Korea are special processed products, components and intermediate products that cannot be procured within Korea, and high-priced famous brand products. Table 4 summarizes ten major export and import products between Korea and Japan for 2000 and 2005.

The analysis now turns to trade between China and Japan. As a result of rapid growth China has been running trade deficits with Japan since 2002. Table 5 summarizes ten major export and import products between China and Japan for 2000 and 2005. In 2005 principal exports to Japan by China were HS85 (electrical machinery and equipment and parts), HS84 (nuclear reactors, boilers, machinery and mechanic), HS62 (articles of apparel and

**Table 5 10 Major Trading Products between China with Japan,  
2000 and 2005**

(unit: %)

Export to China				Import from China			
2000		2005		2000		2005	
Product	Share	Product	Share	Product	Share	Product	Share
HS85	30.5	HS85	29.7	HS62	16.0	HS85	16.9
HS84	19.6	HS84	21.5	HS85	15.3	HS84	16.5
HS72	6.8	HS90	8.7	HS61	10.8	HS62	9.1
HS39	6.2	HS72	6.0	HS84	5.8	HS61	7.8
HS90	5.8	HS39	5.3	HS27	4.6	HS90	4.7
HS29	4.6	HS29	5.1	HS90	3.5	HS27	3.7
HS87	3.1	HS87	4.2	HS16	3.4	HS16	3.0
HS55	2.0	HS74	1.9	HS63	2.6	HS94	2.3
HS54	1.9	HS73	1.7	HS64	2.3	HS87	2.2
HS74	1.6	HS38	1.4	HS3	2.2	HS73	2.0

Source: Korea International Trade Association, KOTIS Data.

clothing accessories, not knitted or crocheted knit), HS61 (articles of apparel and clothing accessories, knitted or crocheted knit). In the same year, Japanese main exports to China were HS85 (electrical machinery and equipment and parts), HS84 (nuclear reactors, boilers, machinery and mechanic), HS90 (optical, photographic, cinematographic), HS72 (iron and steel), HS39 (Plastics and articles thereof). Japanese major export products to China did not change from 2000 to 2005.

### 3. THE EXPORT AND IMPORT STRUCTURES

#### 3.1. The Countries Export Structures

The study now compares the export structures of the three countries in 2000 and 2005. Table 6 summarizes shares of 10 major exports of Korea,



**Table 6 Shares of 10 Major Exports of Korea, Japan, and China, 2000 and 2005**

(unit: %)

KOREA				JAPAN				CHINA			
2000		2005		2000		2005		2000		2005	
Product	Share	Product	Share	Product	Share	Product	Share	Product	Share	Product	Share
HS85	26.9	HS85	28.3	HS85	25.1	HS87	21.0	HS85	18.5	HS85	22.6
HS84	17.3	HS84	13.6	HS84	21.3	HS85	20.6	HS84	10.8	HS84	19.7
HS87	8.9	HS87	13.2	HS87	18.6	HS84	20.0	HS62	7.6	HS62	4.6
HS27	5.4	HS89	6.1	HS90	7.0	HS90	6.1	HS61	7.2	HS61	4.1
HS89	4.8	HS27	5.5	HS72	2.7	HS72	4.1	HS64	4.0	HS90	3.3
HS39	4.2	HS39	5.0	HS29	2.5	HS29	3.0	HS95	3.7	HS94	2.9
HS72	3.5	HS72	4.5	HS39	2.3	HS39	2.9	HS27	3.1	HS95	2.5
HS29	2.9	HS90	4.2	HS89	2.1	HS89	2.0	HS94	2.8	HS64	2.5
HS54	2.8	HS29	3.7	HS40	1.3	HS73	1.6	HS42	2.6	HS73	2.5
HS60	1.5	HS73	1.6	HS73	1.1	HS40	1.4	HS39	2.6	HS39	2.3

Source: Korea International Trade Association, KOTIS Data.

Japan, and China, 2000 and 2005. In both years Korea and China had HS85 (electrical machinery and equipment) and HS84 (nuclear reactors, boilers, machinery and mechanic) as the first and the second major exports, respectively. For products ranked below the third situations a degree of dependency on exports comes in at high levels for HS87 (vehicles other than railway or tramway rolling stock), HS89 (ships, boats and floating structures), HS39 (plastic and articles thereof), and HS72 (iron and steel) in Korea and for HS62 (articles of apparel and clothing accessories, not knitted or crocheted knit), HS61 (articles of apparel and clothing accessories, knitted or crocheted knit), and HS90 (Optical, photographic, cinematographic) in China. This shows that Korea still has a competitive edge over China in capital-intensive industries such as automobiles, ships, and steels, even though Korea has been rapidly losing competitiveness to China in the area of light industrial products.

Korea and Japan have the same three industries as the top three exports (HS85, 84, and 87). In the case for Japan, these three industries carry about the same weights, and these weights remain approximately constant from 2000 to 2005. On the contrary the exports of Korea were skewed heavily toward HS85 as the first exchange earner, and such dependence actually increased in 2005 (from 26.9% to 28.3%), mainly due to the expansion of investments in IT industries.<sup>4)</sup>

The export structures of the three countries show some similarities, especially for the three big exporting industries. Korea as the middle country among these three is closer to China than to Japan. Japanese export structure shows more stability in the period from 2000 to 2005. Korea and China are more dependent on the two major exports, HS85 and 87 for Korea and HS 85 and 84 for China, with shares higher in 2005 than in 2000. For the two countries, Korea and China, the rise of product HS 85 was remarkable (from 26.9% to 28.3% for Korea and from 18.5% to 22.6% for China).

### **3.2. Import Structures of the Countries**

The import structures of Korea and Japan were quite stable from 2000 to 2005 because of the relatively developed structures of the economies. For example the first three major imported products are HS27, HS85, and HS84, with fairly unchanged shares over the period. Japan had the same three industries as the three major imports in both years, with shares slightly higher in 2005 than in 2000. Chinese import structures seemed to be less stable. In 2005, the third major imported products were from industry HS62, replacing HS27. Moreover, the share of imported product HS85 did not change much from 22.5% in 2000 to 22.6% in 2005, and HS84 jump from 15.3% in 2000 to 19.7% in 2005. Table 7 summarizes shares of 10 major imports of Korea, Japan, and China, 2000 and 2005.

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<sup>4)</sup> The share of the export products, which reflects the industrial structure, suggests that industrial structure of Japan is very stable. On the other hand, changes in the export products of Korea and China are relatively radical in the industrial structure recently.

**Table 7 Shares of 10 Major Imports of Korea, Japan, and China, 2000 and 2005**

(unit: %)

Korea				Japan				China			
2000		2005		2000		2005		2000		2005	
Product	Share	Product	Share	Product	Share	Product	Share	Product	Share	Product	Share
HS27	23.7	HS27	25.9	HS27	20.4	HS27	25.8	HS85	22.5	HS85	22.6
HS85	22.1	HS85	18.7	HS85	13.2	HS85	11.9	HS84	15.3	HS84	19.7
HS84	13.0	HS84	10.7	HS84	11.1	HS84	10.1	HS27	9.2	HS62	4.6
HS90	4.2	HS72	6.3	HS90	3.6	HS90	3.9	HS39	6.4	HS61	4.1
HS72	3.7	HS90	4.9	HS3	3.4	HS26	2.7	HS72	4.3	HS90	3.0
HS29	3.1	HS29	3.2	HS44	3.0	HS87	2.7	HS29	3.7	HS94	2.9
HS71	1.8	HS39	2.1	HS62	2.7	HS3	2.2	HS90	3.2	HS95	2.5
HS39	1.7	HS26	2.0	HS87	2.7	HS29	2.2	HS74	2.1	HS64	2.5
HS76	1.3	HS87	1.6	HS61	2.2	HS62	2.2	HS48	1.8	HS73	2.5
HS26	1.3	HS38	1.5	HS29	2.1	HS44	2.1	HS44	1.7	HS39	2.3

Source: Korea International Trade Association, KOTIS Data.

### 3.3. Trade in Agriculture among the Three Countries

The study will now examine trade in agriculture among the three countries and the rest of the world. It worthwhile to look at trade in agriculture among China, Japan, and Korea, as the agricultural sectors in Korea and Japan are highly protected and potential obstacles to a bilateral or trilateral FTA. Table 8 shows the percentage trade in agriculture (HS01 to HS23) among Korea, China, Japan, and the rest of the World in 2005.

South Korea is not a big exporter of agriculture. For example, 0.96% of the global imports for South Korea were in agriculture, and the corresponding figure for China is only a mere 0.49%. Japan did rely more on Korea, as 5.3% of imports from Korea were in agriculture. Korea was also a big importer of agriculture, as 4.1% of its import was agriculture. It depended much more on China. Table 8 shows that Japan is a big importer of agriculture, not only from the rest of the world but also from Korea and China.

**Table 8 Percentage Trade in Agriculture among Korea, Japan, China, and the Rest of the World in 2005**

(unit: %)

	Export from			
	Korea	China	Japan	World
Korea	–	7.7	0.66	4.1
China	0.49	–	0.47	3.04
Japan	5.3	8.9	–	9.3
World	0.96	3.25	0.45	–

#### 4. CHARACTERISTICS OF THE TRADE RELATIONS

##### 4.1. Competitive Export Relations among the Three Countries

The trade specialization indices is first considered their to examine the export competition among Korea, China, and Japan. For industry  $i$  in country  $A$ , the specialization index,  $TSI$ , is defined as

$$TSI_{Ai} = \frac{X_{Ai} - M_{Ai}}{X_{Ai} + M_{Ai}}, \quad (1)$$

where  $X_{Ai}$  and  $M_{Ai}$  represent the export and the import of product  $i$  by country  $A$ , respectively. The index  $TSI$  lies between  $-1$  (when  $X_{Ai} = 0$  and  $M_{Ai} > 0$ ) and  $+1$  (when  $X_{Ai} > 0$  and  $M_{Ai} = 0$ ), and a positive (negative) number reveals the country's comparative advantage (disadvantage) in the product.

Table 9 presents the  $TSIs$  of the ten major export and import industries in China, Japan, and Korea. The table reveals several interesting features. First, the  $TSIs$  of ten major export industries in Korea are on the whole lower than those of China and Japan. Second, the  $TSIs$  of ten major export products in Korea are generally lower in 2005 than in 2000 except for HS85 (Electrical

**Table 9 Trade Specialization Indices of Korea, China, and Japan, 2000-2005**

(unit: %)

	Korea		Japan		China	
	2000	2005	2000	2005	2000	2005
HS2	-0.87	-0.98	-1.00	0.07	0.08	0.12
HS3	-0.08	-0.42	-0.92	-1.00	0.30	0.20
HS26	-0.98	-0.97	-0.99	-0.86	-0.95	-0.92
HS27	-0.60	-0.62	-0.96	-0.99	-0.45	-0.57
HS29	0.00	0.11	0.19	-0.94	-0.33	-0.40
HS38	-0.55	-0.53	0.22	0.22	-0.38	-0.24
HS39	0.46	0.45	0.33	0.33	-0.39	-0.30
HS40	0.42	0.42	0.53	0.34	-0.10	-0.01
HS42	0.50	-0.56	-0.97	0.45	0.98	0.96
HS44	-0.86	-0.93	-0.99	-0.98	-0.28	0.06
HS54	0.72	0.66	0.79	-0.98	-0.47	0.22
HS61	0.71	0.23	-0.96	0.61	0.94	0.96
HS62	0.45	-0.31	-0.95	-0.97	0.92	0.95
HS64	0.49	-0.16	-0.97	-0.96	0.94	0.94
HS71	-0.11	-0.21	-0.59	-0.97	0.42	0.23
HS72	0.00	-0.12	0.58	-0.47	-0.45	-0.27
HS73	0.33	0.27	0.42	0.56	0.53	0.54
HS76	-0.41	-0.38	-0.55	0.38	-0.51	0.10
HS84	0.18	0.16	0.42	-0.56	-0.12	0.22
HS85	0.13	0.25	0.41	0.39	-0.05	-0.01
HS87	0.81	0.80	0.79	0.33	0.11	0.15
HS89	0.95	0.88	0.96	0.80	0.66	0.81
HS90	-0.56	-0.04	0.42	0.98	-0.07	-0.33
HS94	-0.06	-0.33	-0.75	0.29	0.93	0.93
HS95	0.08	-0.33	-0.08	-0.71	0.95	0.94

machinery and equipment). This suggests that Korea exports the less specialized products, and consequently Korea is facing more competition than China and Japan. The export structure of Korea is more vulnerable against domestic and foreign shocks than China and Japan. Kim and Cho

**Table 10 Export Similarity Indices of China, Japan, and Korea, 2000-2005**

	2000	2001	2002	2003	2004	2005
Korea and China	0.596	0.623	0.639	0.635	0.643	0.637
Korea and Japan	0.729	0.713	0.724	0.737	0.741	0.744
Japan and China	0.517	0.545	0.572	0.603	0.641	0.647

(2003) compare the movement of *TSIs* of major products of Korea and China from 1990 to 2000 and find that Korea lost competitiveness in the products of clothing, footwear, furniture, and toys against China.

Second is the examination of the export similarity index (*ESI*) between two countries, A and B, which is defined as follows

$$ESI_{AB} = \sum_i \min \left( \frac{X_{Ai}}{X_A}, \frac{X_{Bi}}{X_B} \right), \quad (2)$$

where  $X_j$  is the total export of country  $j$ ,  $j = A, B$  and  $X_{Ai}$  and  $M_{Ai}$  represent the export and the import of product  $i$  by country  $A$ , respectively. It is a positive number not greater than 1. If the export structures of the countries are more similar, then the index should be closer to 1.

Table 10 shows the *ESIs* between any two of the three countries from 2000 to 2005 using HS 2 digit codes. The table reveals that the export structures of China, Japan, and Korea are becoming similar to each other over time, suggesting that the competition among the three countries in the world market is intensifying. The *ESIs* between China and Japan increased especially fast. One implication is that the rapid economic growth of China is a bigger threat to Japan than to Korea. However, it is important to note that in these years the export competition between Korea and Japan remained the most severe among the three countries.

The present results can be compared with those by Kim (2004) and Park (2003). The former measured the *ESIs* of China, Japan, and Korea using HS

4 digit codes and the latter using HS 6 digit codes. Both Kim and Park found that the *ESIs* between Korea and Japan were more stable than what Table 10 suggests.

Third is to look at the market shares of selected industries in Korea, China, and Japan in the US market which is the largest importing country in the world (table 11). It shows that market shares of China in these industries increased steadily, while those of Korea and Japan decreased over time, with Japan experiencing a faster drop. However, this does not imply that the competitiveness of Japan is decreasing because Japan has diversified export markets by increasing exports to East Asia.

Table 11 taken from Kim (2004) shows more details. For HS8471 (automatic data processing machines and units thereof) and HS8473 (Parts and Accessories NESOI For Typewriters and OT) the market shares of Korea and Japan decreased since 2000, but the market share of China grew rapidly and reached 42.6% in 2005, which is much larger than those of Korea (3.2%) and Japan (8.4%). Korean and Chinese market shares rapidly increased since 2000 while the Japanese market share decreased For HS8517 (electrical apparatus for line telephony) and HS8525 (transmission apparatus for radio-telephony) which are two major export products for Korea. For HS8541 (diodes, transistors and similar semiconductor devices) and HS8542 (electronic integrated circuits and micro assemblies), Korean and Japanese market shares declined due to the growing exports of multilateral firms located in Southeast Asian countries, while the market share of China gradually rose. For HS87 (vehicles other than railway or tramway), the market share of Korea increased from 3.2% in 2000 to 5.1% in 2005, while the market share in Japan decreased from 26.2% in 1998 to 24.8% in 2003. Chinese market share for HS87 has reached just 2.1% in 2005. For HS89 (ships, boats, and floating structures), Korea and Japan had the duopoly market power in world market. For HS72 (iron and steel), HS73 (articles of iron and steel), the market share in Korea decreased from 5.2% in 2000 to 4.3% in 2005 and the market share in Japan also declined from 8.0% to 5.5% during the same period. China rapidly absorbed the market shares of Korea

**Table 11 Market Shares in the US of Selected Industries of China, Japan, and Korea, 2000-2005**

(unit: %)

		2000	2001	2002	2003	2004	2005
HS8471 HS8473	Korea	8.8	6.3	6.1	4.8	4.3	3.2
	China	11.4	13.7	19.3	28.4	37.7	42.6
	Japan	16.4	13.9	11.9	10.2	9.0	8.4
HS8517 HS8525	Korea	8.6	14.2	14.3	16.3	18.8	11.5
	China	8.6	10.3	15.2	19.2	24.8	29.8
	Japan	18.5	15.4	14.3	12.8	11.0	9.5
HS8541 HS8542	Korea	15.7	11.6	13.3	13.8	14.8	11.9
	China	1.6	2.2	2.8	3.4	5.1	6.9
	Japan	17.7	15.5	11.6	10.8	11.7	11.4
HS87	Korea	3.2	4.3	4.3	4.9	5.7	5.1
	China	1.2	1.0	1.1	1.4	1.8	2.1
	Japan	26.2	25.8	26.6	24.6	23.9	24.8
HS89	Korea	0.2	0.3	0.2	2.0	27.2	14.7
	China	2.6	4.5	2.1	2.3%	2.5	4.9
	Japan	2.0	1.6	5.0	1.1	0.7	1.1
HS72 HS73	Korea	5.2	5.1	4.4	3.8	3.6	4.3
	China	7.9	9.5	10.7	13.5	13.4	16.0
	Japan	8.0	8.5	7.1	6.7	4.9	5.5
HS54 HS55	Korea	13.0	12.2	11.9	11.8	11.4	11.2
	China	3.3	3.1	4.2	5.1	5.5	10.2
	Japan	8.8	8.1	6.6	6.6	6.6	5.3
HS39	Korea	2.5	2.3	2.6	2.7	2.9	3.2
	China	15.3	16.9	18.5	18.7	19.5	20.9
	Japan	9.1	7.8	7.1	6.8	6.6	5.8

and Japan, rising from 7.9% in 2000 to 16% in 2005. For HS54 (man-made filaments) and HS55 (man-made fibers), market shares in China increased from 3.3% in 2000 to 10.2% in 2005, even though the market share in Korea was still fairly large being above 11% in recent years. For HS39 (plastics and articles of thereof), the market share in China was large in 2000, and became a more dominating figure in 2005.



**Table 12 Intra-regional Trade Share of China, Japan, and Korea, 2000-2005**

(unit: %)

		2000	2001	2002	2003	2004	2005
Intra-regional Trade Share	Export	19.5	19.6	20.3	22.4	23.2	22.4
	Import	22.9	22.0	23.5	25.4	26.3	25.6

#### 4.2. Complementary Trade Relationship among the Three Countries

Turning to the complementarity nature of the exports of these three countries it is important to first examine the intra-regional trade shares of the three countries (table 12). In general, a higher intra-regional trade share of a group of countries implies that the countries are more inter-dependent in trade. Table 12 shows that both in terms of export or import, the three countries had rising intra-regional shares from 2000 to 2005: Intra-regional export share increased from 17.5% in 2000 to 22.4% in 2005, and intra-regional import share also increased from 22.2% to 25.6% during the same period. It is concluded that these figures are very high (though lower than the corresponding figures for NAFTA and EU), considering the fact that the countries do not have a free trade agreement. One principal reason for high intra-regional trade among the countries is that they have vertically differentiated industries and are geographically close to each other.

The export market intensity index from country  $A$  to country  $B$ ,  $EMI_{AB}$ , is defined as follows

$$EMI_{AB} = \frac{X_{AB}/X_A}{M_B/M}, \quad (3)$$

where  $X_{AB}$  represents the exports from country  $A$  to a country  $B$ ,  $X_A$  means the total exports of the country  $A$ ,  $M_B$  means the total imports of the country  $B$ , and  $M$  means the total imports of the world. An  $EMI$  greater than 1, which occurs when the export share of the country  $A$  to the country  $B$  is greater than

**Table 13 Export Market Intensity Indices of China, Japan, and Korea, 2000-2005**

A	B	2000	2001	2002	2003	2004	2005
Korea	China	3.14	3.17	3.29	3.40	3.32	3.58
	Japan	2.28	1.97	1.75	1.86	1.97	1.92
China	Korea	2.11	2.26	2.33	2.17	2.11	2.11
	Japan	3.21	3.04	2.79	2.83	2.85	2.51
Japan	China	2.81	2.74	2.76	3.05	3.11	3.00
	Korea	3.02	2.94	2.99	3.45	3.81	3.66

the export share of the world to the country *B*, implies that country *B* is trade-dependent on country *A*.

Table 13 presents the *EMIs* of the three countries from 2000 to 2005. All the numbers are greater than 1, showing how the economies are mutually trade dependent on each other. To China, the *EMI* of Korea (3.58 in 2005) is higher than that of Japan (3.00), implying that the structure of exports from Korea is more suited to the market in China. Alternatively, China is more important for the exports from Korea's than for Japan. The *EMI* of Korea to Japan (1.92 in 2005) is lower than the *EMI* of China to Japan (2.51), which implies that Japan is a more important market to China than to Korea. These numbers reflect the fact that exports from China are specialized mainly in low-price consumption products such as apparel, clothes, footwear, toys, and furniture that are suited to the demands of Japan. The *EMI* of Japan to Korea (3.66) is higher than the *EMI* of China to Korea (2.11), showing that industries in Korea depend heavily on Japan.

The Grubel-Lloyd index (Grubel and Lloyd, 1975) is now used to measure the degree of intra-industry among the countries. The intra-industry trade index of industry *i* between two countries is defined as

$$IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}. \quad (4)$$

Note that the index is symmetric between the countries. The index lies between 0 (when either  $X_i$  or  $M_i$  is zero while trade exists) and +1 (when  $X_i = M_i > 0$ ).

Table 14 presents the intra-industry trade indices of ten major export and import industries in China, Japan, and Korea. The industries with relatively high indices between Korea and China in 2005 are HS27 (Mineral fuels, oils, waxes), HS71 (Pearls, precious or semi-precious stones), HS72 (Iron and steel), HS73 (Articles of iron and steel), HS85 (Electrical machinery and equipment). For intra-industry trade between Korea and Japan, the industries with high indices are HS40 (Rubber and articles thereof), HS73 (Articles of iron and steel), HS76 (Aluminum and articles thereof), HS90 (Optical, photographic, cinematographic). Between China and Japan, the industries with high indices on the list of intra-industry trade in 2005 are HS73 (Articles of iron and steel), HS76 (Aluminum and articles thereof), HS84 (Nuclear reactors, boilers, machinery), HS89 (Ships, boats and floating structures). It is interesting to note that even though the major export industries of Korea, China, and Japan are HS84 and HS85, the *IITs* are not that high because products in these industries are mostly expensive items, raising the importance in terms of the values of trade. However, these countries had significant trade imbalances, implying low intra-industry trade indices. Another point to note is that the industries with relatively high *IITs* in 2005 also had relatively high *IITs* in 2000.

Another way to show the degree of intra-industry trade between two countries is to aggregate the individual index of the industries. The aggregate intra-industry trade index between two countries is defined as<sup>5)</sup>

$$IIT = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i |X_i + M_i|} \quad (5)$$

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<sup>5)</sup> The formula defined here does not take into consideration the possibility of non-zero trade balance. To see how an alternative formula corrects for a possible trade imbalance, see Grubel and Lloyd (1975) and Wong (2004).

**Table 14 Intra-industry Trade Indices of Major Export Industries  
among China, Japan, and Korea, 2000 and 2005**

(unit: %)

	Korea & China		Korea & Japan		China & Japan	
	2000	2005	2000	2005	2000	2005
HS2	0.00	0.00	0.16	0.00	0.01	0.00
HS3	0.30	0.21	0.33	0.47	0.26	0.24
HS26	0.05	0.08	0.55	0.68	0.65	0.33
HS27	0.77	0.82	0.18	0.30	0.22	0.59
HS29	0.27	0.25	0.41	0.49	0.31	0.34
HS38	0.71	0.66	0.21	0.18	0.54	0.51
HS39	0.10	0.19	0.75	0.56	0.38	0.47
HS40	0.51	0.54	0.57	0.69	0.34	0.56
HS42	0.43	0.13	0.05	0.17	0.02	0.02
HS44	0.47	0.09	0.64	0.43	0.02	0.05
HS54	0.33	0.43	0.53	0.62	0.05	0.19
HS61	0.12	0.26	0.05	0.16	0.01	0.01
HS62	0.37	0.26	0.27	0.33	0.08	0.03
HS64	0.95	0.68	0.05	0.22	0.02	0.03
HS71	0.86	0.87	0.91	0.55	0.95	0.46
HS72	0.77	0.97	0.61	0.51	0.32	0.37
HS73	0.90	0.69	0.97	0.89	0.92	0.99
HS76	0.55	0.72	0.92	0.98	0.82	0.79
HS84	0.68	0.65	0.69	0.50	0.46	0.78
HS85	0.88	0.73	0.63	0.64	0.67	0.65
HS87	0.52	0.15	0.39	0.50	0.58	0.60
HS89	0.75	0.32	0.05	0.02	0.45	0.75
HS90	0.60	0.28	0.16	0.57	0.76	0.62
HS94	0.39	0.47	0.56	0.75	0.04	0.19
HS95	0.62	0.34	0.95	0.46	0.17	0.16

The *IIT* takes a value between 0 (when all industries have an intra-industry trade index equal to 0) and 1 (when all industries have an index equal to 1).

**Table 15 Intra-industry Trade among Korea, China, Japan, 2000- 2005**

	2000	2001	2002	2003	2004	2005
Japan and China	0.40	0.43	0.45	0.46	0.48	0.52
Korea and Japan	0.52	0.52	0.50	0.49	0.49	0.52
Korea and China	0.56	0.58	0.54	0.53	0.55	0.57

A larger index represents a higher degree of intra-industry trade between the two countries. It has been argued that the *IIT* is positively correlated with the level of a national per capita income, market size, similarity of factor endowments, and activities of multi-national firms (Kim and Choi, 2001).

Table 15 presents the aggregate intra-industry trade index between any two of the three countries from 2000 to 2005. All three countries showed high degree of intra-industry trade with each other. The degree of intra-industry trade by Korea with China and Japan has been fairly stable over the period of 2000-2005. However, the Chinese trade with Japan has been steady in a rising trend during the same period.

For the purpose of comparison, see Lim (2004) which provided horizontal and vertical intra-industry trade index (IIT) over the period of 1990-2002. Using the adjusted Grubel-Llyod index, he found that the horizontal IIT index has continuously increased in Japan-Korea, Japan-China, and Korea-China trade for the most relevant years of the time period. The horizontal IIT index between Japan and Korea was highest over the time period of 1990-2002, followed by the Korea-China index and Japan-China index, in order.

Lim also found that the IIT index has a relatively low portion in Japan-China trade due to a large difference in factor endowment between the two countries. In contrast, the IIT index has a relatively high portion in the case of Korea-China trade, since a small difference of factor endowments exists in the two countries. However, the vertical IIT (which is a trade between the commodities showing a large difference in price, technology, and quality) has a relatively low portion of total IIT in Korea-Japan, Japan-China, and

Korea-China. Additionally, the portion of vertical IIT out of total IIT has declined in Korea-Japan, Japan-China, and Korea-China since the second half of 1990s, while the portion of horizontal IIT has been relatively increased.

## 5. CONCLUSION

This paper explores trade structures and relations among the three countries in Northeast Asia, China, Japan, and Korea, showing that they are very trade dependent on each other, with important inter-industry and intra-industry trade. Some major features of trade among the countries, such as trade balances and trade in agricultural products, are carefully investigated.

It is first noted that the export structures are becoming similar to each other. Second, as the export structures of three countries are become similar the competition in the world market is also more intense. Looking at the *TSI*, the *ESI*, and changes in the US market share of these countries from 2000 to 2005, it is concluded that competition in particular between Korea and China and between China and Japan is more intensified. The result points out that Korea and Japan may be facing considerable pressure from China as the latter has been growing rapidly.

The Results suggest that Korea and Japan have more than rivalry and competition from China, as there is much complementarity between the exports of these countries. That is because the three economies are in different stages of development and many of the industries (especially the manufacturing industries) show strong vertical differentiation. The results indicate that they have high degrees of intra-industry trade and that the intra-regional trade shares have been steadily rising in the past several years. They also have high intra-industry trade indices. The IIT among three countries showed a high degree of correlation with each other.

**Table 16 Definitions of the HS Codes**

Code	Product	Code	Product
01	Live animals	49	Printed books, new paper, pictures
02	Meat	50	Silk
03	Fish, crustaceans, mollusks	51	Wool, fine or coarse animal hair
04	Dairy products, birds eggs, honey	52	Cotton
05	Other products of animal origin	53	Other vegetable textile fibers, paper yarn
06	Live trees, live plants, bulbs	54	Man-made filaments
07	Edible vegetables, roots	55	Man-made staple fibers
08	Edible fruit and nuts	56	Wedding, felt and nonwovens
09	Coffee, tea, mate	57	Carpets and other textile floor coverings
10	Cereals	58	Special woven fabrics, tufted textile
11	Products of milling industry	59	Impregnated, coated, covered textile
12	Oil seeds, oleaginous fruit, medicine	60	Knitted or crocheted fabrics
13	Lac, gums, vegetable products	61	Articles of apparel and clothing, knitted
14	Vegetable plaiting materials	62	Articles of apparel and clothing, not knitted
15	Animal or vegetable fats, oils	63	Other made up textile articles, sets
16	Preparation of meat, of fish	64	Footwear, headgear, umbrellas
17	Sugars and sugar confectionery	65	Headgear and parts thereof
18	Cocoa, cocoa preparations	66	Umbrellas, sun umbrellas, walking-sticks
19	Preparations of cereals, flour, milk	67	Prepared feathers and down
20	Preparations of vegetables, fruit, nuts	68	Articles of stone, plaster, cement, asbestos
21	Miscellaneous edible preparations	69	Ceramic products
22	Beverages, spirits, vinegar	70	Glass and class
23	Residues, wastes from food industry	71	Pearls, precious pr semi-precious stones
24	Tobacco, tobacco substitutes	72	Iron and steel
25	Salt, earths, stone, cement	73	Articles of iron and steel
26	Ores, slag, ash	74	Copper and articles thereof
27	Mineral fuels, oils, waxes	75	Nickel and articles thereof
28	Inorganic chemicals	76	Aluminum and articles thereof
29	Organic chemicals	78	Lead and articles thereof
30	Pharmaceutical products	79	Zinc and articles thereof
31	Fertilizers	80	Tin and articles thereof
32	Tanning or dyeing extracts, paint	81	Other base metals, cermets

33	Essential oils, cosmetic preparations	82	Tools, implements, cutlery, spoons
34	Soap, candles	83	Miscellaneous articles of base metal
35	Albuminoidal substances, glues	84	Nuclear reactors, boilers, machinery
36	Explosives, matches	85	Electrical machinery and equipment
37	Photographic and cinematographic	86	Railway or tramway locomotives
38	Miscellaneous chemical products	87	Vehicles other than railway or tramway
39	Plastics and articles thereof	88	Aircraft, spacecraft and parts thereof
40	Rubber and articles thereof	89	Ships, boats and floating structures
41	Raw hides and skins (other than fur skins)	90	Optical, photographic, cinematographic
42	Articles of leather or animal gut, harness	91	Clocks and watches and parts thereof
43	Fur skins and artificial fur	92	Musical instruments, parts
44	Wood and articles of wood, wood charcoal	93	Arms and ammunition, parts
45	Cork and articles of cork	94	Furniture, bedding, mattresses, cushions
46	Manufactures of straw, esparto	95	Toys, games and sports requisites
47	Pulp of wood or of other fibrous cellulous	96	Miscellaneous manufactured articles
48	Paper and paperboard, articles of paper	97	Works of art, collectors pieces and antiques

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