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CHANGING COMPARATIVE ADVANTAGE AND INTRA-INDUSTRY TRADE IN KOREAN MANUFACTURING INDUSTRIES

TAEGI KIM · SANGHO KIM*

This paper investigates changing patterns of trade in Korean manufacturing industries based on the theories of comparative advantage and intra-industry trade. Korea's comparative advantage in manufacturing industries has shifted toward more physical and human capital intensive sectors over time, but Korea still has comparative advantage in labor intensive sectors compared to Japan and the United States. The level of Korea's intra-industry trade has increased rapidly; since 1980 it has been greater than Japan's. Moreover, Korea's intra-industry trade has become more important in capital intensive sectors over time. The increase of Korea's intra-industry trade is related to the growth of per capita income, trade liberalization, and the increase of foreign direct investment.

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I. INTRODUCTION

The Korean economy has changed rapidly during the last 30 years. Korea's GDP in constant 1990 US dollars has grown from $23.1 billion in 1962 to $363.9 billion in 1995. Per capita GDP has grown from $105 in 1962 to $11,773 in 1995. During the same period, the annual growth rate of total trade was 22.5%, and the share of manufactured products in total trade increased from 52.1% in 1962 to 86.4% in 1995. Such changes in the Korean economy have changed its trade patterns.

This paper will investigate changing patterns of trade in Korean manufactur-

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* Chonnam National University · Honam University

ing industries based on theories of comparative advantage and intra-industry trade. The two concepts are not mutually exclusive. Helpman (1981) and Helpman and Krugman (1985) give a synthesis approach to inter-industry trade and intra-industry trade. Comparative advantage continues to determine inter-industry trade, while scale economies and product differentiation lead to intra-industry trade even when countries have identical factor endowments. Therefore, even if countries have identical relative factor endowments, they will still trade, but all trade will be intra-industry trade based on economies of scale and product differentiation. Intra-industry trade is an extension of the theoretical explanation of trade flows; it explains some of trade flows that are not explained by comparative advantage.

We investigate how Korea's patterns of comparative advantage and intra-industry trade have changed. We also compare Korea's trade patterns to those of Japan and the United States. This comparison will show the differences between Korea's trade patterns and developed countries' trade patterns. This paper complements Hong (1987, 1989) and Kim (1992) which have shown that Korea's trade patterns conform to predictions by both the theory of comparative advantage and the theory of intra-industry trade.

Section II presents hypotheses on changing Korean trade patterns and defines the measures of trade patterns. Section III describes the changing patterns of Korean trade using the measurement methods explained in Section II. The determinants of trade patterns are investigated in the aspects of comparative advantage and intra-industry trade in Section IV. Section V gives concluding remarks.

II. HYPOTHESES AND MEASURES OF TRADE PATTERNS

2.1. Hypotheses on Korea's Trade Patterns

Comparative advantage is determined by the factor endowments of a country. Therefore, trade patterns based on comparative advantage will change as shifting factor endowments lead to changes in comparative advantage.[1] We expect Korea's overall commodity composition of exports in manufactured products to have shifted towards more capital intensive sectors as capital stocks have increased more rapidly than labor over time.[2] However, Korea may still have comparative advantage in labor intensive sectors because Korea is a labor

[1] Krueger(1977) has proposed that, in a small open economy, the capital intensities of exported goods increase with capital accumulation

[2] According to Pyo(1988) total net physical capital stock in Korea incresed by 13.0 percent per annum during 1973-86. On the other hand the economical active population incresed by 2.6 percent per annum and the number of workers employed in manufacturing incresed by 6.1 percent per annum during 1973-86.

abundant country relative to Japan and the United States, Korea's most important trading partners.

Intra-industry trade theory suggests several hypotheses on trade patterns that are supported empirically.[3] First, intra-industry trade increases as a country's per capita income increases. Second, intra-industry trade is higher between countries with similar market sizes. Third, intra-industry trade rises when trade barriers fall. As trade barriers fall, there is more competition at home which drives industries toward specialization and differentiation to survive. There are also more opportunities to export which lead industries to expand in those product areas where they can export and take advantage of economies of scale. Fourth, intra-industry trade is related to foreign direct investment. Foreign direct investment may be either a complement or a substitute for intra-industry trade. Caves (1981) offers both a complementary relationship and a substitutable relationship.

Based on the theory of intra-industry trade, some hypotheses can be drawn about structural changes in Korea's trade patterns over time. Korea's intra-industry trade should have expanded beginning in the 1960s as the economy developed, market size increased, trade barriers decreased, and foreign direct investment increased. In particular, the intra-industry trade share of total trade in the more capital intensive sectors should have increased with capital accumulation over time.[4]

2.2. Net Export Index and Intra-Industry Trade Index

To analyze the changing trade patterns of Korea, Balassa's (1977) net export index and Grubel-Lloyd's (1975) intra-industry trade index are used. Both indices are biased measures when there is overall trade imbalance. To overcome this problem, both indices have been adjusted for the manufactured products trade imbalance with the adjustment scheme proposed by Aquino (1978).

Balassa's net export index is defined as net exports divided by the sum of exports and imports for a particular industry,

$$S_{ik}=\frac{(X_{ik}-M_{ik})}{(X_{ik}+M_{ik})} \tag{1}$$

where X_{ik} and X_{ik} stand for exports and imports respectively, while i refers to a industry (SITC 3 digit), and k refers to a country.

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[3] See Greenaway and Milner (1986) for the detailed explanation to the hypotheses on intra-industry trade.

[4] If we take into account economies of scale and product differentiation in Krueger's(1977) model, we can easily derive this proposition.

The net export index of comparative advantage is, however, affected by the country's overall trade balance. To adjust for this trade balance effect, we assume that it is equiproportional to all industries.[5] Then the net export index adjusted for trade imbalance is defined here as:

$$T_{ik}=\frac{(X^e_{ik}-M^e_{ik})}{(X^e_{ik}+M^e_{ik})} \tag{2}$$

where $X^e_{ik}=(1/2)X_{ik}\{\sum_{i=1}^{n}(X_{ik}+X_{ik})/\sum_{i=1}^{n}X_{ik}\}$ and

$M^e_{ik}=(1/2)M^e_{ik}\{\sum_{i=1}^{n}(X_{ik}+M^e_{ik})/\sum_{i=1}^{n}M^e_{ik}\}$.

X^e_{ik} and M^e_{ik} are, respectively, adjusted exports and adjusted imports in industry i of a country k. Since this study is limited to trade patterns in manufacturing industries, we have used the trade imbalance of manufactured products as the correcting device.

As a measure of intra-industry trade we have used the Grubel-Lloyd (1975) intra-industry trade index (GL index). The GL index is defined as:

$$B_{ik}=1-\frac{|X_{ik}-M_{ik}|}{(X_{ik}+M_{ik})} \tag{3}$$

The index, B_{ik}, takes values from zero to one. The value of the index increases with intra-industry trade.

If the total trade of a country is not balanced, the GL index underestimates intra-industry trade. Thus we need to adjust for the trade imbalance effect. This adjustment is made by the Aquino index, defined as:

$$Q_{ik}=1-\frac{|X^e_{ik}-M^e_{ik}|}{(X^e_{ik}+M^e_{ik})} \tag{4}$$

where X^e_{ik} and M^e_{ik}, respectively, refer to the adjusted exports and imports of country k's industry i, as defined in equation (2).

[5] This way of correcting for trade imbalance is used originally by Aquino(1978) for a measure of intra-industry trade.

III. CHANGING TRADE PATTERNS OF KOREA

3.1. Comparative Advantage

The product classification schemes used in this study are the 3 digit SITC Revision 1 categories and 3-digit ISIC categories. Manufactured products of SITC 3-digit are classified into 5 groups; nondurable consumer goods (I), labor intensive intermediate products (II), durable consumer goods (III), capital goods (IV), and capital intensive intermediate products (V).[6]

Table 1 show the capital-labor ratio of each product group for selected years. The capital-labor ratio of each product group has been computed from fixed capital formation and persons employed in a given industry. Physical capital of each industry is estimated as the sum of fixed capital formation over the preceding 10 years, expressed in constant prices and converted into US dollars at the 1985 exchange rate. Fixed capital is assumed to depreciate at an annual rate of 15%.

Product groups I-V are numbered in descending order of labor intensity in production. The nondurable consumer goods group (I) is the most labor intensive group while the capital intensive intermediate goods group (V) is the most capital intensive group. Although product group II is somewhat more capital intensive than product group III in 1975 and 1980, the difference of capital-labor ratios between two groups is not large and product group III become more capital intensive than product group II in 1985 and 1990. Korea's

[Table 1] Capital Intensities of Product Groups, Korea

Product Group[2]	Capital/Labor[1]			
	1975	1980	1985	1990
I	4.75	6.11	5.95	12.09
II	6.64	8.71	8.87	16.67
III	5.95	8.37	10.18	21.31
IV	6.72	10.42	11.74	22.48
V	12.53	21.30	21.17	41.34
Total Average	6.69	9.92	10.59	21.50

Source: UN, Industrial Statistics Yearbook (Tape).

Note: 1) The unit of capital intensities is thousands of 1985 U.S. dollars per person.

2) I denotes nondurable consumer goods, II denotes labor intensive intermediate products, III denotes durable consumer goods, IV denotes capital goods, and V denotes capital intensive intermediate products.

[6] See Appendix Table. This classification of product groups is adopted from MITI(Japan), White Paper(1986) which used 3-digit of SITC(rev. 1) in this classification. Thus we have established a rough correspondence between the 3-digit SITC and 3-digit ISIC.

[Table 2] Average Levels of Net Export Indices for Korea, Japan and the United States

Product Group	Product Category	Period	S_j			T_j		
			Korea	Japan	USA	Korea	Japan	USA
I	Nondurable Consummer Goods	66-75	88.1	43.2	−45.9	91.1	−0.7	−49.7
		76-85	94.0	−17.0	−59.4	92.4	−66.0	−57.2
		86-95	84.8	−62.7	−66.1	81.7	−80.6	−56.6
II	Labor Intensive Intermediate Products	66-75	13.2	60.1	−22.3	23.4	23.2	−27.4
		76-85	45.4	41.6	−19.4	33.4	−8.4	−14.5
		86-95	31.8	6.0	−30.8	19.9	−30.1	−13.3
III	Durable Consummer Goods	66-75	−34.9	84.1	−19.3	−24.2	59.9	−25.3
		76-85	41.2	89.5	−36.9	26.5	68.0	−32.1
		86-95	58.9	71.0	−44.6	48.0	45.1	−27.2
IV	Capital Goods	66-75	−73.8	51.7	49.0	−68.5	7.0	44.4
		76-85	−23.7	68.2	31.5	−38.0	15.9	37.2
		86-95	−14.1	64.7	2.6	−26.5	26.6	22.1
V	Capital Intensive Intermediate Products	66-75	−63.2	39.6	−2.6	−56.9	13.7	−7.4
		76-85	−13.5	39.8	−8.5	−25.5	2.1	−3.8
		86-95	−18.2	15.0	−6.9	−29.8	−22.4	10.6

Source: UN, Trade Tapes

Note: Definitions of product groups I - V are the same as in Table 1. S_j is unadjusted net export indices and T_j is adjusted net export indices.

average capital-labor ratio for total manufacturing industries increases from 6.69 in 1975 to 21.50 in 1990. This implies that Korea's capital stock has increased more rapidly than labor and that production has rapidly intensified capital utilization.

Table 2 shows the transformation of the structure of comparative advantage over time in Korea, Japan, and the United States. Net export indices have been calculated for 102 manufacturing industries of SITC 3 digit, and the results aggregated into 5 product groups. As a summary measure of the net export indices in each product group j, we have used a weighted average of the values of S_{ik} or T_{ik} with weights given by each industry's share in commodity group j's total trade. S_j and T_j are the weighted average levels of the unadjusted indices and adjusted indices, respectively, for product group j of country k in each year. The figures in Table 2 are the simple averages of S_j and T_j for about 10 years, calculated to reduce the effects of business cycles.

Average levels of the unadjusted net export indices indicate that Korea always has comparative advantage in product groups I and II, the most labor intensive groups. In product group III, Korea has comparative advantage beginning in 1976. However, in the capital intensive product groups IV and V, Korea is always at a comparative disadvantage. The unadjusted net export indices of Japan show unusual trade patterns. Japan is at a comparative disadvantage only in product group I during 1976-95, and has comparative advantage in the other product groups at all times. This is due to Japan's large trade sur-

plus in manufactured products. The United States always has comparative advantage in product group Ⅳ, and is at a comparative disadvantage in product group Ⅰ, Ⅱ, and Ⅲ, the labor intensive groups.

The adjusted net export indices indicate that Korea has comparative advantage in product groups Ⅰ and Ⅱ, Japan always has comparative advantage in product groups Ⅲ and Ⅳ, and the United States is always at a comparative advantage in product group Ⅳ. This implies that, in general, Korea is a labor abundant country, the United States is capital abundant country, and Japan is in the middle in terms of relative capital endowments.[7]

The adjusted indices (T_j) in Table 2 also show that comparative advantage shifts toward capital intensive sectors in all three countries. In product group Ⅲ Korea's net import changed to net export in 1976, and the net import share becomes smaller over time in product groups Ⅳ and Ⅴ even if Korea still has comparative disadvantage in these product groups. In product group Ⅴ the United States has comparative advantage beginning in 1986. Japan shows more notable changing patterns of comparative advantage. Japan always has comparative advantage in groups Ⅲ and Ⅳ. It loses comparative advantage in labor intensive product groups Ⅰ and Ⅱ over time, but it gains comparative advantage in capital intensive product group Ⅳ.

[**Table 3**] Simple Average levels of Intra-Industry Trade; Korea, Japan, and the United States

	B			Q		
YEAR	Korea	Japan	USA	Korea	Japan	USA
62-65	19.8	34.0	50.2	25.6	39.1	52.0
66-70	22.6	36.0	56.2	26.6	44.0	55.7
71-75	34.5	41.9	57.5	34.7	47.3	57.8
76-80	39.1	39.9	59.9	38.6	44.0	60.1
81-85	43.3	38.6	57.7	43.6	43.5	58.7
86-90	44.6	42.4	59.1	44.6	45.3	62.6
91-95	50.5	45.3	65.6	50.4	48.0	68.4

Source: UN, Trade Tapes

Note: B is unweighted average level of Grubel-Lloyd index and Q is also unweighted average level of Aquino index for a given period.

[7] The trade patterns between Korea and the United States are complementary in terms of patterns of comparative advantage, because Korea is labor abundant compared to the United States. The correlation coefficients between Korea's net export indices(S) and the USA's net export indices(S) are negative and significant at the one percent level every year during 1962-90, while the correlation coefficients between Korea's net export indices(S) and Japan's net export indices(S) are positive and insignificant.

3.2. Intra-Industry Trade

We have measured the Grubel Lloyd index (B) and the Aquino index (Q) at the three digit level of SITC for Korea, Japan, and the United States. The figures in Table 3 are the simple average levels of intra-industry trade for relevant period. The average level of intra-industry trade is highest in the United States, and those levels are relatively stable over time. The levels of intra-industry trade increased more rapidly between 1962 and 1995 in Korea than in Japan or the United States. Before 1980 Korea's average levels of intra-industry trade were lower than those of Japan, but after 1980 they became higher.

In Korea and the United States, trade imbalance adjustment does not change the general picture. The difference between B and Q is smaller in Korea and the United States than that in Japan. Japan's average levels of intra-industry trade calculated by the Aquino index are consistently higher than those calculated by the G L index. Moreover, Japan's average levels of intra-industry trade computed by the Aquino index are higher than those of Korea even after 1980, except for 1991-95. It suggests that Japan's large trade imbalance in manufacturing industries makes its actual levels of intra-industry trade lower than Korea.

Table 4 shows the pattern of changes in Korean intra-industry trade for the different groups of manufactured products during 1962-95. The figures in Table 4 clearly suggest that the average levels of intra-industry trade have risen for all product groups during this time. Greater increases of the average intra-industry trade level are recorded for product groups IV and V, which are capital intensive groups.[8]

Using weighted average levels of intra-industry trade, we can relate the lev-

[Table 4] Korea's Intra-Industry Trade and C/B by Product Group

	B					C/B				
YEAR	I	II	III	IV	V	I	II	III	IV	V
62-65	24.9	28.1	29.6	8.5	15.1	0.64	0.75	0.98	0.61	0.83
66-70	21.8	32.9	39.2	13.7	14.5	0.42	0.97	0.64	0.87	0.79
71-75	22.5	49.3	43.7	32.1	28.2	0.33	1.04	1.17	1.25	1.08
76-80	28.4	44.7	44.7	48.3	33.6	0.20	0.85	1.14	1.09	1.12
81-85	34.9	46.5	48.5	48.8	40.1	0.14	0.82	1.08	1.28	1.19
86-90	40.1	54.5	41.5	46.1	41.2	0.14	0.94	0.88	1.31	1.26
91-95	49.9	53.5	57.2	46.9	49.1	0.44	0.93	0.79	1.25	1.24

Source: UN, Trade Tapes

Note: The definitions of B and C are the same as in Tables 3.

[8] These result support Kim's (1992) argument that Korea's intra-industry trade has shifted to more capital intensive sectors. In Kim(1992), manufactured products have been classified into five product groups according to factor intensities.

els of intra-industry trade to the trade shares of each industry. The weighted average is defined here as:

$$C_k = \sum_{i=1}^{n} B_{ik} W_{ik} \tag{5}$$

where $W_{ik} = (X_{ik} + M_{ik}) / \sum_{i=1}^{n} (X_{ik} + M_{ik})$.

The ratio of C to B shows the importance of intra-industry trade in capital intensive sectors of Korea's manufacturing industries. In product group I, the most labor intensive group, the ratio C/B has decreased over time, but in product group V, the most capital intensive sector, the ratio C/B has increased over time. This implies that the trade share of high intra-industry trade industries is larger in product group V than in product group I, even if the average intra-industry trade index of product group V is similar to that of product group I. The prevalence of growth in intra-industry trade across product groups suggests that Korea's trade in manufacturing industries is rapidly becoming more intra industry and, consequently, less inter industry in character.

Ⅳ. THE DETERMINANTS OF TRADE PATTERNS

4.1. Comparative Advantage

In analyzing econometrically the factors determining the structure of comparative advantage in Korea's manufacturing industries, the net export index, S_{ik}, is used as the dependent variable. Based on Heckscher-Ohlin trade theory, we have formulated two regression equations. One relates the net export index to flow measure of the capital-labor ratio.

$$S_i = \alpha_0 + \alpha_1 KL_i \tag{6}$$

where KL represents a capital-labor ratio which is a ratio of non-wage share of value added to wage share of value added in a given industry. A positive (negative) α_1 coefficient shows that a country has a comparative advantage in capital (labor) intensive products.

Next, Korean trade patterns in manufacturing industries have been estimated by regressing net exports indices on industry factor usage. The factors of production include unskilled labor, physical capital, and human capital.

$$S_i = \beta_0 + \beta_1 LAB + \beta_2 PCAP + \beta_3 HCAP \tag{7}$$

where LAB represents unskilled labor, PCAP represents physical capital, and HCAP represents human capital.

In constructing the explanatory variables, factor intensity is defined as that

[Table 5] The Determinants of Inter-Industry Trade in Korean Manufacturing Industries

Explanatory Variable	1965	1975	1985	1995
constant	0.398**	0.646***	0.536***	0.220*
	(2.54)	(4.23)	(3.75)	(1.73)
KL	−0.280***	−0.267***	−0.194***	−0.114***
	(5.40)	(5.23)	(4.05)	(2.67)
F-value	29.128	27.296	16.407	7.110
R^2	0.238	0.221	0.146	0.069
constant	−1.733***	−0.699*	−1.063**	−0.435
	(4.11)	(1.69)	(2.63)	(1.14)
LAB	3.486***	1.721	2.342**	0.827
	(3.25)	(1.63)	(2.27)	(0.85)
PCAP	0.364**	0.124	0.391**	0.108
	(2.10)	(0.73)	(2.35)	(0.67)
HCAP	−4.746***	−5.684***	−3.970***	−2.170*
	(3.48)	(4.38)	(3.13)	(1.80)
F-value	19.978	20.787	12.353	3.484
R2	0.397	0.399	0.283	0.101

Note: The figures in parentheses are t-statistics. Regression coefficients that are significant at the 1% level are denoted by ***, those significant at the 5% level by **, and those significant at the 10% level by *.

factor's share of value added.[9] The relative shares of unskilled labor, physical capital, and human capital in value added have been derived from United Nations data of Korean industry.[10]

Estimation has been done by regressing net export indices of comparative advantage for manufacturing industries on the explanatory variables just described. The data for explanatory variables, LAB, PCAP, HCAP, have been averaged for each industries considered for the years 1975, 1980, 1985, and 1990 to eliminate business cycle effects, since the components of value added may fluctuate due to business cycle and lead to shifts in the factor intensity rankings. Estimates have been made with ordinary least squares (OLS) method for the years 1965, 1975, 1985 and 1995.

The results are shown in Table 5. The upper part of Table 5 shows the results of regression equation (6), which considers only capital and labor as production factors and uses the ratio of non-wage share to wage share as an

[9] Regression equation(9) is borrowed from Balassa and Noland(1989). They argue that the share specification yields an unambiguous ranking of industries by factor intensity in the multifactor model and has a straightforward interpretation in terms of the multifactor Hecksher-Ohlin model.

[10] United Nations, *United Nations Industrial Statistics*. The human capital here is defined as wage payments in excess of average wage of total manufactures. Physical capital of each industry is estimated as the sum of fixed capital formation over the preceding 10 years, expressed in constant prices and converted into US dollars at the 1985 exchang rate. Fixed capital is assumed to depreciate at an annual rate of 15%.

explanatory variable. The results show that all estimated signs of the variable, KL, are negative and statistically significant at the 1% level. This implies that Korea has had a comparative advantage in labor intensive manufactured products during 1965-1995. The results also show that magnitude of estimated coefficients for KL has increased over time, which implies that Korea's comparative advantage has moved to capital intensive sectors over time even if it still has comparative advantage in labor intensive products.

The lower part of Table 5 shows the results of regression equation (7), which considers three factors of production. The results show that all coefficients for the variables LAB and PCAP are positive, but they are not statistically significant in 1975 and 1995 regressions.[11] All coefficients for the variable HCAP are negative and statistically significant at the 1% or 10% level. This implies that Korea did not have comparative advantage in human capital intensive products. However, the magnitude of estimated coefficients for HCAP has increased over time. This implies that Korea's comparative advantage has been shifting toward more human capital intensive sectors over time.

4.2. Intra-Industry Trade

On the basis of the hypotheses on intra-industry trade introduced in section 2, the following relationship is posited:

$$B_{kt} = r_0 + r_1 AYP_{kt} + r_2 DY_{kt} + r_3 TAR_{kt} + r_4 FDI_{kt} + r_5 Dumm_k \qquad (8)$$

where B_{kt} represents the Grubel-Lloyd index of year t in Korea's trade with county k. We choose Japan and the United States as Korea's trading partners.[13] Korea's trade share with these two countries is over 50%.[12]

The variable AYP is the average per capita GNP of the two countries, and the variable DY is the ratio of GDP differences to the sum of GDP of the two countries. The variable TAR is an average tariff rate of the two countries. The tariff rate of each country here is the ratio of tariff revenue to total import value. The variable FDI is the average of foreign direct investment of the two countries.[14] Dumm is a dummy variable for Japan, Dumm = 1 for

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[11] Trade structures in 1975 and 1995 are different from those in 1965 and 1985, which makes the coefficients of explanatory variables, LAB and PCAP, are not statistically significant in 1975 and 1995.

[13] Kim(1992) covers 33 countries whose trade of manufactured products with Korea are relatively large. In this paper, we would like to see that the results of Kim(1992) are obtained in a small sample.

[12] Korea's average trade share with Japan and the United states in total trade is 72.8% during 1962-1970, 59.2% durint 1971-1980, and 50.7% during 1981-1990.

[14] The variables AYP, DY, TAR, and FDI are calculated from data between Korea and Japan, or Korea and the United States.

[Table 6] The Determinants of Intra-Industry Trade in Korea's Trade with Japan and the United States

Explanatory Variable	(1)	(2)	(3)	(4)	(5)
constant	−13.78	79.73***	93.52***	106.73***	22.81
	(0.30)	(5.30)	(7.68)	(6.61)	(5.32)
AYP (+)	1.55***	1.10***	0.98***		
	(6.07)	(7.33)	(3.65)		
DY (−)	45.34	−49.47***	−79.40***	−0.84***	
	(0.96)	(3.02)	(6.15)	(5.67)	
TAR (−)	−2.12***	−2.06***	0.71		0.41
	(4.85)	(4.42)	(1.21)		(0.57)
FDI (+/−)	2.52	19.99***	25.18***		
	(0.44)	(5.54)	(6.98)		
Dum (+)	7.06**				6.35***
	(2.11)				(5.36)
F-value	56.35	68.84	37.73	47.30	28.94
R2	0.821	0.805	0.848	0.765	0.756

Note: The figures in parentheses are t-statistics. Regression coefficients that are significant at the 1% level are denoted by ***, those significant at the 5% level by **, and those significant at the 10% level by *.

Japan and Dumm=0 for the United States.[15] According to the theoretical hypothesis of section II, the expected signs of AYP and Dumm are positive and the expected signs of DY and TAR are negative, but the expected sign of FDI is not certain. Foreign direct investment may be a complement or a substitute for intra-industry trade. If foreign direct investment is complementary to intra-industry trade, the expected sign is positive, and if it is a substitute for intra-industry trade, the expected sign is negative. The regressions have been estimated using ordinary least squares (OLS).

The regression results are reported in Table 6. There is multicollinearity among some explanatory variables. To address this problem we have changed specifications in each regression. In regression (1) of Table 6, all the explanatory variables are statistically significant, except for the variable DY. Regression (2) of Table 6 excludes the variable Dumm whose correlation with DY is high. In regression (2) all variables are significant at the 1% level. The results of (1) and (2) show that the extent of Korea's intra-industry trade is positively correlated with average per capita incomes (AYP) and preference similarity or 1/distance (Dumm), and it is negatively correlated with differences in country size (DY) and tariff rate (TAR). These show that Korea's trade patterns shift to intra-industry trade as its per capita income increases and the difference in GDP between Korea and Japan or the United States decreases.

[15] Japan is nearer to Korea than the United States, and Japanese culture is more similar to Korea's. Thus Dumm represents distance and consumer preferences.

The negative sign on the tariff (TAR) variable implies that intra-industry trade increases with trade liberalization. The positive sign of the variable Dumm indicates that Korea's intra-industry trade is larger in trade with Japan than in trade with the United States. It is because Japan is geographically close and has more similar preferences to Korea.

Regression (3) shows that the variables AYP and DY have the expected signs and are significant statistically, but the variables TAR and FDI are not significant even at the 10% level. One of the reasons is multicollinearity between AYP and FDI. Regression (4) shows that the coefficient of the variable FDI is positive and significant statistically. In regression (5) where Dumm is included while excluding DY whose correlation with Dumm is high, the coefficients of the variables FDI and Dumm have the expected positive signs and are significant statistically. The positive sign on FDI suggests that foreign direct investments between Korea and Japan or the United States are complementary to intra-industry trade. That is, the extent of intra-industry trade has increased as foreign direct investments between two countries increase.[16]

V. CONCLUDING REMARKS

This paper has examined changing trade patterns in Korean manufacturing industries on the basis of the theories of comparative advantage and intra-industry trade. The descriptive analyses show that Korea's comparative advantage in manufacturing industries has shifted to more capital intensive sectors over time, but that Korea still has comparative advantage in labor intensive sectors compared to Japan and the United States. According to the changes in intra-industry trade indices, the level of intra-industry trade has increased more rapidly in Korea than in Japan and the United States. In particular, Korea's average levels of intra-industry trade have increased more rapidly in capital intensive sectors than in labor intensive sectors. This implies that intra-industry trade has become more important in capital intensive sectors over time.

Regression analysis support the results of the descriptive study. If we consider only labor and capital as factors of production, Korea has had comparative advantage in labor intensive sectors through 1995. However, if we consider human capital in addition to labor and capital, Korea has had comparative advantage in labor and capital intensive sectors, but it has not had comparative advantage in human capital intensive sectors.

Regression analyses on intra-industry trade show that the levels of intra-in-

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[16] Caves(1981) and Kim(1992) find substitutability between foreign direct investment and intra-industry trade. Lee(1989), however, shows a significant positive sigh on FDI, which suggests that foreign direct investment and intra-industry trade are complementrary. The differences of estimates signs for FDI among studies may be due to the difference of data set for FDI. Caves and Kim have used FDI of each industry, and Lee has used FDI between two countries as in this study.

dustry trade in Korea have increased as per capita income increased and trade liberalized. The coefficient of the foreign direct investment variable is positive and statistically significant, which implies that Korea's foreign direct investment with Japan and the United States is complementary to trade. The estimated coefficient of the Japan dummy variable is positive and significant statistically. It means that the average levels of intra-industry trade between Korea and Japan are higher than those between Korea and the United States. This is because Japan is geographically nearer and consumer preferences are similar to Korea.

On the basis of our study, we may expect that there is a tendency for intra-industry trade to become more important over time in Korea's trade. Intra-industry trade arises from product differentiation and economies of scale rather than from factor endowment differences between countries. Therefore, Korea will develop or import a technology to differentiate products, and it will specialize in a narrower range of products to take advantage of economies of scale by exporting goods.

Appendix Table: Product Groups with SITC(rev. 1) and ISIC

Product Group	Product Category	SITC(rev. 1)	ISIC
I	Nondurable Consummer Goods	553, 571, 654, 656, 657, 831, 841, 842, 851, 863, 892, 895, 899	322, 323, 324, 342, 352, 390
II	Labor Intensive Intermediate Products	611, 612, 613, 631, 632, 633, 651, 652, 653, 655, 662, 663, 664, 665, 667, 691, 692, 693, 694, 698	321, 323, 331, 362, 369, 381, 390
III	Durable Consummer Goods	666, 696, 697, 724, 725, 732, 733, 812, 821, 864, 891, 893, 894, 896, 897	332, 356, 361, 381, 383, 384, 385, 390
IV	Capital Goods	695, 711, 712, 714, 715, 717, 718, 719, 722, 723, 726, 729, 731, 734, 735, 861	382, 383, 384, 385
V	Capital Intensive Intermediate Products	512, 513, 514, 515, 521, 531, 532, 533, 541, 551, 554, 561, 581, 599, 621, 629, 641, 642, 661, 671, 672, 673, 674, 675, 676, 677, 678, 679, 681, 682, 683, 684, 685, 686, 687, 688, 689, 862	341, 351, 352, 354, 355, 369, 371, 372, 381,

REFERENCES

Aquino, A. "Intra-Industry Trade and Inter-Industry Specialization as Concurrent Sources of International Trade in Manufactures," *Weltwirtschaftliches Archiv*, 114, 1978, 275-296.

Balassa, Bela "Comparative Advantage in Manufactured Goods: a reappraisal," *Review of Economics and Statistics*, 68, 1986, 315-319.

Caves, R.E., "Intra-Industry trade and Market Structure in the Industrial Countries," *Oxford Economic Papers*, 33, 1981, 203-23.

Greenaway, D. and C. R. Miller, *The Economics of Intra-Industry Trade*, New York: Basil Blackwell, 1986.

Grubel, H., and P. Lloyd, *Intra-Industry Trade*, London: Macmillan, 1975.

Helpman, E. "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition," *Journal of International Economics*, 11, 1981, 305-340.

Helpman, E. and P. Krugman, *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and the International Economy*, Cambridge: MIT Press, 1985.

Hong, Wontack, "A Comparative Static Application of the Heckscher-Ohlin Model of Factor Proportions: Korean Experience," *Weltwirtschaftliches Archiv*, 123, 1987, 309-324.

Hong, Wontack, Factor Intensities of Korea's Domestic Demand, "Production and Trade: 1960-85," *International Economic Journal*, 3, 1989, 97-113.

Kim, Taegi, "Intra-Industry Trade: The Korean Experience," *International Economic Journal*, 6, 1992, 95-113.

Krueger, A.O., *Growth, Distortions, and Patterns of Trade among Many Countries*, Princeton Studies in International Finance, No.40, Princeton: Princeton University press, 1977.

Krugman, Paul "Increasing Returns, Monopolistic Competition and International Trade," *Journal of International Economics*, 9, 1979, 469-479.

Lancaster, K., "Intra-Industry Trade under Perfect Monopolistic Competition," *Journal of International Economics*, 10, 1980, 151-176.

Lee, Young Sun, "A Study of the Determinants of Intra-Industry Trade among the Pacific Basin Countries," *Weltwirtschaftliches Archiv*, 125, 1989, 346-358.

Linder, S.B., *An Essay on Trade and Transformation*, New York: John Wiley, 1961.

Pyo, Hak-Kil, "Estimates of Capital Stock and Capital/Output Coefficients by Industries: Korea (1953-86)," *International Economic Journal*, 2, 1988, 79-121.

U.S. Department of Commerce, *Bureau of Economic Analysis, Selected Data on U.S. Direct Investment Abroad, 1950-1976*, Washington D.C.