

Determinants of Intra-Industry Trade in Man-Made Fibers

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인조섬유 산업에 있어서의 산업내 무역의 결정요인

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요 약

본 연구의 목적은 두가지 인조섬유 산업, 즉 합성섬유 산업(SITC 266)과 재생섬유 산업(SITC 267)에 있어서, 산업내 무역의 결정요인을 조사하는데 있다. 20 개의 주요 인조섬유 수출 국가들을 대상으로 1977, 1982, 1987년의 세 시기에 걸쳐 자료가 수집되었다. 국제무역 유형을 알아보기 위해 산업내 무역 모델이 사용되었고 종속 변인으로 Grubel-Lloyd 지수가 사용되었다. 산업내 무역을 결정하는 독립변인으로는 국가특성 변인, 국가간 변인, 산업특성 변인의 세 종류가 쓰였다. 국가특성 변인에는 시장규모, 일인당 소득, 자본-노동 비율 변인들이 사용되었고, 국가간 변인으로는 국가간 거리, 인접국경, 공통언어, 동일 경제블럭 변인들이 사용되었다. 산업특성 변인에는 규모의 경제와 제품차별성 변인들이 쓰였다. 자료의 분석을 위해서는 비선형자승 방법이 이용되었다. 본 연구의 결과, 일인당 소득과 자본-노동의 비율 변인들은 인조섬유의 산업내 무역에 중요하지 않은 것으로 나타났다. 그러나, 시장규모, 국가간 거리, 인접국경, 규모의 경제, 제품차별성 변인들은 모든 시기에 걸쳐 산업내 무역에 유의한 영향을 미치는 것으로 나타났다. 또한, 공통언어 사용과 동일 경제블럭 변인들도 대부분의 시기에 인조섬유의 산업내 무역에 유의한 영향을 미치는 것으로 나타났다.

I. INTRODUCTION

The man-made fiber industry has become a major world industry since its expansion in the 1960s. Man-made fibers accounted for 46 percent of total world fiber production in 1990 compared to 23 percent in 1960 (*Textile Organon*, 1971 & 1993). The utilization of man-made fibers in household furnishings and industrial applications was responsible

for this growth. The growth of man-made fiber production was followed by the expansion of international trade in man-made fibers. Total world exports of man-made fibers increased by more than four times from \$1.2 billion in 1970 to \$5.8 billion in 1990 (Balch, 1993).

The developed countries were the major producers of man-made fibers for several decades. However, the production technology of some man-made fibers became well established and well

known over time, and thus man-made fibers are now produced in the developing countries. Such fibers are likely to be standardized products and price competitive. Fibers which require a more sophisticated technology and are less price competitive are more likely to be produced in the developed countries than in the developing countries (Toyne et al, 1984).

Krugman and Obstfeld (1991) give two reasons why countries specialize and trade. First, countries differ either in their resources or in their technology, and thus specialize in the things they do relatively well. Second, economies of scale make it advantageous for each country to specialize in the production of a limited range of goods. Most theories of international trade since the 1940s were based on the first reason. This model was based on the principle of comparative advantage and described inter-industry trade where inter-industry trade was defined as trade in products of different industries. For example, the capital abundant country would export capital intensive products such as automobiles and import labor intensive products such as apparel.

In the early 1960s, many economists became interested in the evolution of trade patterns in the European Economic Community (EEC). Verdoorn (1960) and Balassa (1966) found evidence of increasing intra-industry specialization in the decade following the formation of the EEC. Intra-industry trade was defined as the simultaneous exports and imports of products of the same three digit industry. According to Greenaway and Milner (1986), over 50 percent of total world trade in manufactures in 1983 was intra-industry trade. Other researchers concluded that a significant proportion of trade in manufactured goods, in particular between developed countries, was intra-industry trade in nature (Balassa & Bauwens, 1987; Bergstrand, 1990). This phenomenon could not be explained by the traditional inter-industry trade

theory. Thus, economists considered an alternative reason for trade. When there are economies of scale, production costs fall as output increases. Under these conditions, large firms usually have an advantage over small firms and markets tend to be dominated by a few large firms. Thus, markets are imperfectly competitive (Krugman & Obstfeld, 1991). Product differentiation also played a role in the theory of intra-industry trade since it encouraged product specialization when there were economies of scale.

The man-made fiber production is very capital and knowledge intensive, and has significant manufacturing economies of scale (Toyne et al, 1984). Thus, the market structure of the man-made fiber industry is oligopoly. It is heterogeneous since the fibers are different. Product differentiation also occurs from the different technical services provided by the firms. Thus, intra-industry trade could occur in the man-made fiber industries.

The results of this study should be of interest to man-made fiber analysts and policy makers who are concerned with the determinants of trade in man-made fibers. The results should also provide information to researchers who are interested in trade patterns of various manufacturing industries.

II. Empirical Hypotheses of Intra-Industry Trade (IIT)

Many hypotheses employed in the analyses of intra-industry trade determinants could be grouped into country-specific, between-country, and industry-specific characteristics. The country-specific variables were market size, per capita income, and the capital-labor ratio. The between-country variables were distance, a common border, a common language, and participation in a customs union. The industry-specific variables were economies of scale and product differentiation.

1. Market Size

The average market size of the trading countries was expected to have a positive impact on trade since a large market can sustain a number of differentiated products. Where there are economies of scale, different countries will specialize in the production of different varieties and trade with one another. In contrast, the difference in market size was expected to have a negative impact on intra-industry trade due to differences in the number of varieties produced in two countries (Lancaster, 1980). There is less incentive for a larger country to trade with a small country. In this study, a country's Gross National Product (GNP) was used to measure market size. Data on GNP were obtained from the 1992 issue of *World Tables* by the World Bank. Data for Taiwan were available from the 1990 issue of *Statistical Yearbook of the Republic of China*.

2. Per Capita Income

Average per capita income was expected to have a positive impact on intra-industry trade since consumers in high income countries are likely to demand differentiated products (Linder, 1961; Loertscher & Wolter, 1980; Balassa & Bauwens, 1987). However, the difference in per capita income between the two trading countries was expected to have a negative impact on intra-industry trade due to differences in demand (Linder, 1961; Gray, 1979). Per capita GNP was used to measure per capita income. Per capita GNP was calculated from GNP divided by the population of each country. Data on GNP and population were obtained from the 1992 issue of *World Tables* by World Bank. Data for Taiwan were obtained from the 1990 issue of *Statistical Yearbook of the Republic of China*.

3. Capital-Labor Ratio

The average capital-labor ratio was expected to

have a positive impact on intra-industry trade since a country with a high capital-labor ratio has more production possibilities. More varieties of a product are likely to be produced and traded between highly factor endowed countries (Dixit, 1980; Helpman, 1981). In contrast, the difference in the capital-labor was expected to have a negative impact on intra-industry trade. Countries that differ in factor endowments have different production possibilities and there is less incentive for trade between countries.

A country's factor endowment ratio was estimated by the capital-labor ratio. This variable was measured by the stock of physical capital divided by the economically active population. In this study, Leamer's formula (1984) was used to calculate the stock of capital. A country's labor endowment was measured by the number of economically active population in each country. Data for gross domestic investment were obtained from the 1976 and 1992 issues of *World Tables* by World Bank. The exchange rate was obtained from the 1991 issue of *International Financial Statistics Yearbook* by the International Monetary Fund. Data for the economically active population were obtained from the International Labor Office, *Yearbook of Labor Statistics*, the OECD, *Labor Force Statistics*, and the Republic of China, *Statistical Yearbook of the Republic of China*. Some missing values for the economically active population were estimated by the trend regression (Jeon, 1994).

4. Distance

Distance was hypothesized to have a negative effect on intra-industry trade due to its impact on transportation costs. Linnemann (1966) discussed two other trade obstacles related to distance: time and information. A greater distance indicates more transportation time and this delays trade. Also, countries are generally better informed about demand in nearby countries than in faraway

countries. Distance was measured by the shortest sea distance plus hinterland distances to the economic centers of the countries concerned (Linnemann, 1966). Some pairs of European countries did not have ports and shared a common border. In this instance, the distance between capital cities was calculated based on data from American Automobile Association (*Planning Map of Europe*, 1993).

5. Common Border

The existence of a common border was expected to have a positive impact on intra-industry trade. In addition to location advantage, it was expected the countries with a common border might be more similar in their preferences than other countries, and hence more likely to engage in intra-industry trade (Grubel and Lloyd, 1975). In this study, a dummy variable was used to indicate a common border between two countries. If two countries shared a common border, the dummy variable was assigned a value of one. It was assigned a value of zero otherwise.

6. Common Language

Common language was expected to have a positive impact on intra-industry trade since it was hypothesized that a common language would reduce communication barriers. In addition, a common language might represent similar culture which would also encourage intra-industry trade. A dummy variable was used to represent a common language. If two countries had a common language, the dummy variable was assigned a value of one. Data on the official languages of countries were obtained from *An Encyclopedic Dictionary of Language and Languages* (Crystal, 1992).

7. Participation in Custom Union

Participation in the European Community (EC) or the European Free Trade Area (EFTA) was

expected to have a positive impact on intra-industry trade due to the absence of tariff or non-tariff barriers between countries in the same customs union. For this study, dummy variables were also used for this variable. If two trading countries were members in the EC or EFTA, the dummy variable was given a value of one.

8. Economies of Scale

There were two measures for this variable due to the fact that it is concerned with trade between pairs of countries. The first measure was the average economies of scale for two trading countries and the second measure was the difference in economies of scale between two countries. Average economies of scale were expected to have a positive impact on intra-industry trade since countries are more likely to specialize in a few varieties of a product in the presence of economies of scale. They will export domestically produced varieties and import varieties that are not produced in their countries (Krugman, 1979; Toh, 1982; Krugman & Obstfeld, 1991). The difference in economies of scale was expected to have a negative impact on intra-industry trade. A country with small economies of scale would have higher production costs than a country with large economies of scale and be at a competitive disadvantage. Thus, intra-industry trade between two countries with different economies of scale is not likely to occur. Economies of scale was measured by the average output per plant in each country and was obtained for non-cellulosic and cellulosic fibers separately. Thus, it was both country and industry specific. Data on the production of non-cellulosic and cellulosic fibers, and the numbers of producing plants of each fiber were obtained from several June issues of *Textile Organon*. Some data for economies of scale were not available either for some countries or for some years. The missing values were estimated by several regression

methods (Jeon, 1994).

9. Product Differentiation

Product differentiation was expected to have a positive impact on intra-industry trade since countries will tend to specialize in different varieties and trade with one another. In this study, product differentiation was measured by the Hufbauer index (Hufbauer, 1970). The Hufbauer index was defined as a coefficient of variation of U. S. export unit values to different countries. A high coefficient of variations reflects a high level of product differentiation. Data for product differentiation were obtained from the United States Department of Commerce, *U.S. Exports, Schedule B, Commodity by Country*.

III. METHODS AND PROCEDURES

1. Selection of Commodities, Time Periods, and Sample Countries

The two major product categories were non-cellulosic fibers (SITC 266) and cellulosic fibers (SITC 267). Three time periods, 1977, 1982, and 1987, were selected for the study. The year 1987 was the most recent year for which complete data were available. A ten year period was chosen to examine differences in the impact of independent variables on trade patterns over time. The countries selected included the major man-made fiber exporting countries in market economies. First, all market economy countries were ranked according to their export shares. Then, the top twenty countries, for which complete data were available or could be estimated, were selected. Fifteen were developed countries while five were developing countries (UN, *World Economic Survey* 1993).

The twenty countries accounted for more than 98 percent of all non-cellulosic fiber exports and from 82 to 92 percent of cellulosic fiber exports in the 1977 to 1987 time period.

2. Intra-Industry Trade Model

The model is specified as follows:

$$GLI_{ijk} = f(\text{AGNP}_{jk}, \text{DGNP}_{jk}, \text{APCI}_{jk}, \text{DPCI}_{jk}, \\ \text{AKLR}_{jk}, \text{DKLR}_{jk}, \text{DIST}_{jk}, \text{BORD}_{jk}, \\ \text{LANG}_{jk}, \text{CUST}_{jk}, \text{AESC}_{jk}, \text{DESC}_{jk}, \\ \text{PDIF}_i)$$

where GLI_{ijk} = Grubel-Lloyd index of IIT in industry i ,

$AGNP_{jk}$ = average GNP,

$DGNP_{jk}$ = difference in GNP,

$APCI_{jk}$ = average per capita GNP,

$DPCI_{jk}$ = difference in per capita GNP,

$AKLR_{jk}$ = average capital-labor ratio,

$DKLR_{jk}$ = difference in capital-labor ratio,

$DIST_{jk}$ = distance between countries,

$BORD_{jk}$ = common border,

$LANG_{jk}$ = common language,

$CUST_{jk}$ = participation in custom union,,

$AESC_{ijk}$ = average economies of scale in industry i ,

$DESC_{ijk}$ = difference in economies of scale in industry i ,

and $PDIF_i$ = product differentiation in industry i ,

where i = industry, $i=1 \& 2$, and

$j \& k$ = country, $j \& k=1, \dots, 20$.

This model was based on intra-industry trade theories (Krugman, 1979, 1980; Lancaster, 1979; Helpman, 1981) and many empirical studies (Loertscher & Wolter, 1980; Toh, 1982; Balassa & Bauwens, 1987; Lee, 1989; Bergstrand, 1990; Hansson, 1991). There were three sets of independent variables: country-specific variables, between-country variables, and industry-specific variables. The country-specific variables are market size (GNP), per capita income (per capita GNP), and capital-labor ratio. The between-country variables are distance, a common border, a common language, and participation in a customs union. The

industry-specific variables are economies of scale and product differentiation.

Two measures were used for four of the independent variables—GNP, per capita GNP, capital-labor ratio, and economies of scale. They were the average value for two trading countries and the difference in values between two trading countries.

3. Dependent Variable

The dependent variable was the Grubel-Lloyd index which is defined as follows (Grubel and Lloyd, 1975):

$$B_{ijk} = 1 - \frac{|X_{ijk} - M_{ijk}|}{X_{ijk} + M_{ijk}} \quad (1)$$

where B_{ijk} = Grubel-Lloyd index,

X_{ijk} = exports from country j to country k in industry i , and

M_{ijk} = imports from country k to country j in industry i

The value of the Grubel-Lloyd index is bounded between zero and one. The index is one if exports of a three-digit industry are equal to imports, which means complete intra-industry trade. The index is zero if only exports or imports occur in trade between two countries. In this instance, there is only inter-industry trade.

The Grubel-Lloyd index is not defined if there is no trade between countries.

4. Non-linear Least Squares Analysis

The dependent variable is the Grubel-Lloyd index and it is bounded by zero and one. The use of Ordinary Least Squares (OLS) to estimate the intra-industry trade model may generate estimates of the Grubel-Lloyd index which are outside the feasible interval (Loertscher & Wolter, 1980 and Tharakan, 1984). Thus, a logistic function was used in preference to the OLS function. The logistic function ensured that the predicted values were within zero and one.

The logistic function is defined as follows:

$$GLI_i = \frac{1}{(1 + e^{-bx_i})} + u_i \quad (2)$$

where GLI_i = Grubel-Lloyd index,

x_i = vector of independent variables (including the constant),

b = vector of coefficients, and

u_i = error term, where

i = industry

The logistic function of the intra-industry trade model is not linear due to the restricted interval of the Grubel-Lloyd index (0.1). Thus, a non-linear least squares (NLLS) analysis was used. For this study, the Gauss-Newton method in the SAS statistical package was used. The t-test was employed to test the significance of individual regression coefficients. However, the F-test and the coefficient of determination (R^2) were inappropriate since the logistic function is non-linear (Srivastava and Giles, 1987, p. 350). Thus, the correlation coefficient between the estimated and actual dependent variables, r , was used to measure the goodness of fit of the model (Judge et al, 1982, pp. 251-254).

The data for the non-cellulosic industry and the cellulosic industry were pooled in the analysis.

IV. RESULTS AND DISCUSSION

1. Trade between Twenty Major Exporting Countries

The Grubel-Lloyd indexes were computed on the basis of trade flows between two trading countries. A country cannot trade with itself, so there were 190 possible trade flows ($20 \times 19 / 2 = 190$). The type of trade which occurred between the twenty countries is given in Table 1. The proportion of trading pairs with some intra-industry trade ranged from 50 percent in 1977 to 72 percent in 1987 for SITC 266 (non-cellulosic fiber industry). The pro-

Table 1. Trade between Twenty Major Exporting Countries by Industry^a

Industry	Type of Trade	Year					
		1977		1982		1987	
		no	%	no	%	no	%
SITC 266	No Trade ^b	39	21	28	14	15	8
	No IIT ^c	56	29	43	23	38	20
	Some IIT	95	50	119	63	137	72
	Total	190	100	190	100	190	100
SITC 267	No Trade ^b	61	32	59	31	31	16
	No IIT ^c	58	31	47	25	57	30
	Some IIT	71	37	84	44	102	54
	Total	190	100	190	100	190	100

a: Maximum number of trade pairs is 190 ($20 \times 19/2$) based on twenty countries.

b: The Grubel-Lloyd index is not defined in this instance.

So these trading pairs were excluded in the analysis.

c: The Grubel-Lloyd index is zero in this instance.

portion of trade pairs with some intra-industry trade also increased over time for SITC 267 (cellulosic fiber industry) though the values were smaller. It ranged from 37 percent in 1977 to 54 percent in 1987. For both industries, the Grubel-Lloyd index was zero in many instances, which indicated no intra-industry trade between trading countries. The proportion of trading pairs with no intra-industry trade ranged from 29 percent in 1977 to 20 percent in 1987 for SITC 266 while it ranged from 31 percent to 30 percent for SITC 267 during the same period.

Information about the Grubel-Lloyd index for the non-cellulosic fiber industry (SITC 266) and the cellulosic fiber industry (SITC 267) is given in Table 2. The average Grubel-Lloyd index for the non-cellulosic fiber industry is higher than that for the cellulosic fiber industry in all time periods. In addition, intra-industry trade increases for both man-made fiber industries in the 1977-1987 period. The average Grubel-Lloyd index increases from

Table 2. Grubel-Lloyd Indexes

Industry		Year		
		1977	1982	1987
SITC 266	Sample Size ^a	151	162	175
	Average	0.24	0.26	0.27
	Std. Dev.	0.34	0.31	0.30
SITC 267	Sample Size ^a	129	131	159
	Average	0.16	0.19	0.19
	Std. Dev.	0.28	0.27	0.28

a: This includes both inter- and intra-industry trade.

Table 3. Analysis of Variance for Grubel-Lloyd Index

Source	DF	Sum of Squares	Mean Squares	F-value
Industry	1	2.2715	2.2715	28.65***
Year	2	0.5072	0.2536	3.20**
Industry × Year	2	0.0084	0.0042	0.05
Error	1134	89.9149	0.0793	
Total	1139	92.7021		

** : significant at 0.05 level

*** : significant at 0.01 level

0.24 in 1977 to 0.27 in 1987 for non-cellulosic fibers while it increases from 0.16 to 0.19 for cellulosic fibers. The results of analysis of variance of the Grubel-Lloyd index are given in Table 3. The two factors were industry and year. The main effect was significant for each factor while the interaction effect was not significant. Thus, industry and time had a significant impact on the Grubel-Lloyd index.

The aggregate Grubel-Lloyd index for each of the twenty individual countries is given in Table 4. The aggregate Grubel-Lloyd index in each industry is obtained by the summation of the Grubel-Lloyd index for each pair of countries weighted by the trade share of the two trading countries. Thus, the aggregate Grubel-Lloyd index reflects the relative importance of the various trade flows. The aggregate Grubel-Lloyd indexes are higher for non-cellulosic fibers (SITC 266) than for cellulosic fibers (SITC 267) in many instances. For all three

Table 4. Aggregate Grubel-Lloyd Index for Twenty Major Exporting Countries

Country	SITC 266			SITC 267		
	Year			Year		
	1977	1982	1987	1977	1982	1987
Australia	0.01	0.05	0.02	0.02	0.03	0.01
Austria	0.75	0.45	0.41	0.30	0.29	0.16
Belgium-Luxembourg	0.57	0.31	0.27	0.34	0.38	0.29
Canada	0.01	0.23	0.49	0.44	0.30	0.57
France	0.71	0.63	0.49	0.51	0.50	0.40
Germany	0.60	0.50	0.42	0.44	0.55	0.38
Ireland	0.46	0.19	0.33	0.22	0.39	0.19
Italy	0.71	0.65	0.50	0.56	0.14	0.06
Japan	0.08	0.53	0.52	0.04	0.20	0.31
Korea	0.06	0.13	0.21	0.02	0.04	0.09
Mexico	0.02	0.33	0.59	0.2E2	0.5E2	0.62
Netherlands	0.64	0.71	0.51	0.11	0.39	0.30
Spain	0.24	0.34	0.23	0.03	0.01	0.06
Sweden	0.01	0.07	0.03	0.12	0.30	0.16
Switzerland	0.76	0.61	0.48	0.11	0.07	0.12
Taiwan	0.14	0.57	0.65	0.07	0.12	0.52
Thailand	0.02	0.01	0.05	0.00	0.05	0.4E2
United Kingdom	0.61	0.55	0.47	0.27	0.45	0.51
United States	0.24	0.34	0.55	0.18	0.16	0.21
Yugoslavia	0.06	0.09	0.62	0.20	0.11	0.10

years, the degree of intra-industry trade is greater for non-cellulosic fibers than for cellulosic fibers.

For non-cellulosic fibers, Canada, Japan, South Korea, Mexico, Taiwan, the United States, and Yugoslavia experienced an increase in intra-industry trade over the 1977-1987 period. In contrast, Austria, Belgium-Luxembourg, France, Germany, Italy, Switzerland, and the United Kingdom show a decrease in intra-industry trade over the same period. The remaining countries vary in their intra-industry trade. For cellulosic fibers, Japan, Mexico, Taiwan, and the United Kingdom experienced an increase in intra-industry trade while Austria, France, and Italy showed a decrease in intra-industry trade over time. Other countries vary in their degree of intra-industry trade.

Non-linear least squares estimation for the logistic function was used to analyze the data and there were two analyses. All thirteen independent variables were used in model A. However, the average per capita GNP, the difference in per capita GNP, the average capital-labor ratio, and the difference in capital-labor ratio variables were insignificant. Both per capita GNP and the capital-labor ratio reflect a country's stage of economic development. The first variable emphasizes the demand side and the second variable emphasizes the production side (Balassa and Bauwens, 1987; Lee, 1988; Bergstrand, 1990). The insignificance of these variables indicates that a country's stage of economic development did not affect intra-industry trade in man-made fibers in the 1977-1987 period. Thus, both per capita GNP and the capital-labor ratio were excluded in model B. Some studies included either the demand or the production variables. This procedure was used in this study and proved unsuccessful. Thus, all four variables were excluded in model B. Tests for heteroscedasticity and multicollinearity showed no serious problems of heteroscedasticity or multicollinearity for either model.

The results of the two models are similar with respect to their correlation coefficients, and the signs and significance of the coefficients of many independent variables. However, model B is more satisfactory than model A since it excludes the four country specific variables which are not significant. The results for model B are given in Table 5. The independent variables and their expected signs are given in the first two columns and the regression coefficients for 1977, 1982 and 1987 are presented in the next three columns. The correlation coefficient, r , ranges from 0.73 to 0.75 for three time periods, which are similar to those obtained in model A. The effects of the independent variables are also similar in many instances.

The major results for model B are as follows.

Table 5. Regression Coefficients for Intra-Industry Trade: Model B^a

	Expected Sign	Year		
		1977	1982	1987
Constant		-3.1259*** (-4.55)	-4.1483*** (-4.35)	-1.8968*** (-3.84)
Average GNP	+	0.0030*** (3.35)	0.0020*** (4.55)	0.0013*** (4.01)
Difference in GNP	-	-0.0012*** (-2.11)	-0.0007*** (-2.59)	-0.0004** (-2.09)
Distance	-	-0.0002*** (-2.67)	-0.0001** (-2.10)	-0.0002*** (-3.76)
Common border	+	0.4743* (1.71)	0.5460** (2.18)	0.6439*** (2.68)
Common language	+	0.5284** (1.93)	0.4443* (1.83)	0.2271 (0.98)
Participation in custom union	+	0.9076** (2.41)	0.7803*** (2.57)	-0.0027 (-0.01)
Average economies of scale	+	0.0573*** (3.07)	0.0387** (2.46)	0.0280** (2.32)
Difference in economies of scale	-	-0.0558*** (-3.52)	-0.0493*** (-3.59)	-0.0349*** (-3.74)
Product differentiation	+	1.6656*** (3.42)	3.4046*** (2.90)	1.0045** (2.55)
correlation coefficient(r)		0.740	0.748	0.730
# of observation		280	293	334

a : t-values in the parentheses

* : significant at the 0.10 level

** : significant at the 0.05 level

*** : significant at the 0.01 level

First, the two market size variables are significant in all three years. Average GNP has a positive impact while the difference in GNP has a negative impact on intra-industry trade. The negative sign of this variable is consistent with the results of previous studies (Loertscher and Wolter, 1980; Balassa, 1986; Balassa and Bauwens, 1987; Bergstrand, 1990). The difference in market size was expected to have a negative impact on intra-industry trade due to the difference in the number of varieties produced in two countries (Lancaster, 1980).

Second, the four between-country variables are significant in most instances. Distance has a negative and significant impact while a common border has a positive and significant impact on intra-industry trade in all three years. A common language and participation in a customs union have a positive and significant impact on intra-industry trade in 1977 and 1982. These results are consistent with the findings obtained by Loertscher and Wolter (1980), Balassa and Bauwens (1987), Bergstrand (1990), and Hansson (1991). That is, distance between the trading countries acts as an inhibitor for intra-industry trade while a common border, a common language, and participation in a customs union act as a facilitator. It should be noted that many empirical studies reviewed in this paper did not include between-country variables.

Third, the results for all three industry specific variables are significant in all three years. Average economies of scale and product differentiation have a positive impact on intra-industry trade while the difference in economies of scale has a negative impact on intra-industry trade. The significance of these variables is in keeping with the theory of intra-industry trade. It should be emphasized that only one industry specific variable, product differentiation, is included since there are only two industries. Intra-industry trade may also be due to other industry characteristics such as product heterogeneity and market concentration, etc.

It was possible to ascertain the role of economies of scale since it was both country and industry specific. Economies of scale were measured by average output per plant for each industry in each country. This procedure differs from earlier studies which used the same industry variable for all trading countries. Data used in this study indicated that there were considerable differences in economies of scale between countries. Output per plant ranged from 100 to 53,850 metric tons for non-cellulosic fibers and from 420 to 68,250 metric tons

for cellulosic fibers in the 1977-1987 period. Thus, the use of the same value for all trading countries is inappropriate for the man-made fiber industries. Hughes (1993) also expressed concern about the use of identical values for all countries. He pointed out that industry characteristics could vary between countries.

V. SUMMARY AND CONCLUSIONS

The objective of this study was to examine international trade patterns in the non-cellulosic (SITC 266) and cellulosic (SITC 267) fiber industries. The sample consisted of twenty major exporting countries in three time periods-1977, 1982 and 1987.

The intra-industry trade model examined trade between pairs of countries. The dependent variable was the Grubel-Lloyd index of intra-industry trade which reflected the degree of intra-industry trade between two trading countries in a given industry. The independent variables consisted of country-specific variables, between-country variables, and industry-specific variables. The country-specific variables were market size (GNP), per capita GNP, and the capital-labor ratio. The between-country variables were distance, a common border, a common language, and participation in a customs union. The industry-specific variables were economies of scale and product differentiation. Non-linear least squares estimation was used to analyze data.

The major results are summarized as follows. First, average GNP had a positive and significant impact on intra-industry trade in all three years while the difference in GNP had a negative and significant impact. The results for market size are consistent with the theory of intra-industry trade (Lancaster, 1980) and the findings of the previous studies (Loertscher and Wolter, 1980; Balassa and Bauwens, 1987; Bergstrand, 1990).

Second, the four between-country variables are significant in most instances. Distance had a negative impact on intra-industry trade while a common border, a common language and participation in a customs union had a positive impact on intra-industry trade in all three years. The signs of all coefficients were consistent with the results of the previous studies (Loertscher and Wolter, 1980; Balassa and Bauwens, 1987; Hansson, 1991).

Third, the three industry specific variables are significant in all three years. Product differentiation had a positive and significant impact on intra-industry trade as expected. Average economies of scale had a positive impact on intra-industry trade while the difference in economies of scale had a negative and significant impact. In this study, economies of scale was measured by average output per plant for each industry in each country. Thus, it was both country and industry specific. This procedure differs from earlier studies which used the same industry variable for all trading countries. Data used in this study indicated that there were considerable differences in economies of scale between countries.

In conclusion, the results of this study indicate that the intra-industry trade model was useful in explaining international trade patterns in man-made fibers. With respect to the increasing trend of intra-industry trade in the man-made fiber industry, our man-made fiber industry would more involve in intra-industry trade. Now our industry exports the low priced, standardized fibers while importing the high priced, high tech fibers. However, under-developing countries such as China and Thailand begin to produce and export the standasized man-made fibers. Thus our man-made fiber industry should develop and export the high tech fibers to get the competitive advantage.

There are some limitaions in this study. First, only one industry specific variable, product differentiation, could be examined in the intra-industry

trade model since there were only two industries. Hence, other industry characteristics such as product heterogeneity and market concentration could not be examined. Second, the impact of exchange rates and a country's trade policy were not considered. Depreciation of a country's currency in a certain period lowers the prices of the country's exports in terms of foreign currency and raises the prices of the country's imports in terms of home currency. This will affect a country's exports and imports. The use of tariffs or quotas for imports and subsidies for exports will also affect a country's exports and imports. Third, future research might consider the use of country specific data for industry characteristics in the intra-industry trade model. The number of industries might also be expanded.

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