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PROCESS OF PRODUCTION AND INTRA-INDUSTRY TRADE IN MANUFACTURES

YOKO SAZANAMI AND NOBORU HAMAGUCHI

I

Kennedy Round tariff cuts and abolition of other trade barriers in the 1960's contributed greatly to the expansion of trade among industrial countries. Proportion of trade between industrial countries in total world trade increased from 55.8% in 1960 to 64.8% in 1970. Much of this trade expansion reflected increase in mutual exchange of commodities produced in the same industry.

Importance of intra-industry trade among industrial countries has been stressed by Balassa [2], Grubel [8], Adler [1] and others. Traditional international trade theory has dealt only with the problem of inter-industry trade such as countries exchanging leather goods to textiles. However in the 1960's, there was a new development in world trade. A country exchanged goods that are produced in the same industry, but differed in type, style or use. The new type of trade was more pronounced in trade between EEC or CACM* member countries than between non-members.

Formation of common market and progress in trade liberalization evidently expanded the market size, eased the access to market information and spreaded the technological knowledge. Thus firms tended to specialize in particular type of products or process of production. Many firms chose suitable location for production within the liberalized region and specialized in particular production process or type of products. As a result of such behavior of the firms, countries tend to export and import products of the same industry. Grubel [8] found that there is a close relationship between formation of EEC and intra-industry trade. While intra-industry trade increased in all the EEC member countries, it increased more rapidly in trade among member countries. In EEC member countries, intra-industry trade as a percentage of total rose from 53% in 1959 to 65% in 1967 for trade between member countries. But it rose only from 44% in 1959 to 53% in 1967 for trade with other trading partners.

Number of economists have tried to give theoretical explanations to intra-industry tade. Linder [14] stressed the importance of quality of products demanded in different countries. High income country will demand high quality products thus they will hold comparative advantage in such products. They will export high quality products in exchange of low quality products that are produced in the same industry. There will be more trade between countries with similar income level. Linder's hypothesis considers domestic demand, particularly domestic market size as an important factor determining cost advantage.

^{*} Central American Common Market.

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Drèze also developed a model that stressed the importance of demestic market size. He found that small country like Belguim is unable to hold cost advantage in differentiated products that differ in design, style and use. They will tend to specialize in standardized products. On the other hand, large country like West Germany will specialize in differenciated products that are more highly fabricated and belong to latter stage of production process.

One of the reasons for the increase in intra-industry trade between industrial countries may be that countries tend to specialize in production process rather than product. Thus they exchange products that are produced in the same industry but at different level of fabrication. For example, small countries export standardized product at earlier stages of production process, while import differentiated products at latter stages of production process from large countries.

In the present study we have developed a model that relates intra-industry trade with production process rather than with product that are taken up in conventional analysis. If Drèze's hypothesis holds, Japan with GNP level similar to that of West Germany will specialize in differentiated products at latter stage of production process. We first compare the commodity structure of trade at different level of production process in West Germany and in Japan. We analyse whether Drèze's hypothesis holds for Japan. And then we proceed to see at which level of production process, intra-industry trade is most pronounced. Whether intra-industry trade is particularly seen in differentiated high processed goods or also common in intermediate and low processed goods.

Π

Drèze, in his study [6], divided process of production into six stages as follows; 1) primary raw materials, 2) processed raw materials, 3) semi-manufactured, 4) primary processed manufactured, 5) secondary processed manufactured and 6) finished manufactured. He grouped 380 commodities into 28 groups according to primary raw materials used in each commodities and then subdivided each group into six stages. He found that intra-EEC export share of West Germany increases as stages of production process proceeds from 1) primary raw materials to 6) finished manufactured. Whereas intra-EEC export shares of Netherlands decline as stages of production proceeds with exception in stage 4 reflecting large steel exports. Drèze attributes this difference in trade pattern of West Germany and Netherlands to the size of domestic market. The cases where small country exporting products at latter stages of production are limited to products of large multinational firms selling at international market.

Drèze's study presents an interesting relationship between export pattern and production process that was not explicitly taken up in conventional analysis. However it is not quite clear why and how he grouped commodities and subdivided production processes into six stages. It also excludes the import side of trade structure that seems important to us. Why will some countries import raw ma-

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terials, semi-manufactured or finished manufactue.

In our present study we used two approaches, both by application of input-output technique tried to analyse the relationships between production process and trade. In our first approach, we define manufacturing production as a sequence of processes where an output of one industry is used as an input in other industry. As a result of such sequences raw materials reache a final stage of finished product. Chenery-Watanabe [5] and Simpson-Tsukui [18] found in their study that by rearranging input coeffecients in input-output table one can form triangular matrix. Such triangular matrix indicates that output from industries at lower part of the matrix will be used as input in industries at upper part of the matrix. Therefore process of production can be viewed as a process that starts from lower part and reaches to an upper part of triangular matrix.

Ozaki-Ishida [15] rearranged 1965 Japanese input-output table into triangular matrix. They grouped 450×350 industrial sectors into seven sub-matrix.

- 1) [MM]—Intermediate Input
- 2) [RM]—Raw material Input
- 3) [E]—Energy Input
- 4) [Aux]—Auxiliary Materials
- 5) [R]—Repair
- 6) [S]—Service
- 7) [V]—Value Added

[MM] is the largest and the most important sector in manufacturing. Thus it is subdivided into 18 submatrix according to raw material inputs.

We used 1970 triangular matrix of Japan that are similar to the one in 1965 and related trade data to calculate following three indices.

- (1) $E_j / \sum_{j=1}^{n} E_j$ (export ratio) $E_j \dots$ exports of j industry
- (2) $M_j / \sum_{j=1}^{n} M_j$ (import ratio) $M_j \dots$ imports of j industry
- (3) $(E_j M_j)/(E_j + M_j) \times 100$ (intra-industry trade index)

The results are given in Figs. 1, 2 and Table I. Industries in Figs. 1 and 2 are ranked according to level of production process as indicated in triangular matrix. Industries at upper rank produce highly fabricated goods whereas industries at lower rank produce intermediate goods and raw materials. Figs. 1 and 2 will show the relationship between structure of trade and production process in Japan. Whether Japan specializes in more fabricated goods at near the final stage of production process or at lower stage of production process. Intra-industry trade index indicates level of intra-industry trade in *j* industry. Instead of taking the absolute difference between the two. Our intra-industry trade index will range between $-100 \sim +100$, minus being import industry and plus being export industry.

As indicated in Fig. 1, Japanese exports are concentrated in highly processed goods. Ship (7.3%) motor vihicle (7.8%) household electrical appliance (4.6%)

0211	Nursery products and		rubber footwear)		septicized materials
	conservation and	2440	Made-up textile goods	3310	Structural clay
	uncultivated forest		(except wearing		products
	materials gathered		apparel)	3320	Glass and glass
0300	Hunting	2510	Wood milling		products
0410	Marine fishery	2720	Paper articles	3390	Other non-metallic
• • • • •	products	2800	Printing and		mineral products
0420	Whale		publishing	3414	Steel ingot
2012	Meat preserved	2910	Leather and fur	3429	Other basic non-
2030	Vegetable and fruit		products (except		ferrous metal products
	preserved		wearing apparel)	3601	Prime mover
2040	Sea food preserved	3111	Basic inorganic	3602	Machine tool and
2050	Grain mill products		industrial chemicals		metal working
2060	Bread and confec-	3112	Basic organic		machinery
	tionery products		industrial chemicals	3603	Industrial machinery
2091	Other food prepared	3113	Synthetic dyestuff	3604	General industrial
2092	Prepared feeds for	3114	Explosive compound		machinery and
	animal and poultry	3118	Chemical manure		equipment
2140	Soft drinks	3119	Other basic industrial	3703	Other weak electrical
2302	Cotton spinning		chemicals		appliances
2303	Wool spinning	3130	Paint, varnish and	3910	Scientific, measuring
2311	Silk and rayon		lacquer		and medical instru-
	weaving	3192	Other chemical	ł	ments
2314	Woollen weaving		products		(including sanitary
2315	Hemp weaving	3291	Miscellaneous coal		goods)
2390	Other fiber products		products	3990	Miscellaneous
2410	Footwear (except	3292	Miscellaneous anti-		industrial products

TABLE I. INDUSTRIES WITH INTRA-INDUSTRY TRADE INDEX $-50 \sim 0 \sim +50$ in JAPAN (Industries are grouped according to Thiangular Matrix)

rolled steel (7.4%) are the major export items. When industries are ranked from high processed goods in triangular matrix, the exports from the first to forty-second industry accounts for 66% of total exports in 1970.

In contrast to exports that are concentrated in highly processed goods, Japanese imports are concentrated in raw material industries that are ranked at the bottom of Fig. 2. Iron ore (6.5%) copper ore (5.5%) woods (7.4%) coal (5.4%) and crude oil (11.8%) are the major import items. In Table I, we listed the industries whose intra-industry trade index ranged between -50 to +50. We assumed that there is a substantial amount of intra-industry trade when index range between $-50 \sim +50$. Intra-industry trade was observed not only among industries that produce highly processed products but also in industries that produce intermediate goods.

In the second approach we assumed that process of production is a sequence of increase in value added ratio. Since value of final product consists of value added in intermediate product used in production, we can assume that proportion of value added in intermediate production process in final product increases as product gets more fabricated. For example value added in final product "bread" includes value added of direct input such as "wheat flour," as well as value added

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0111 2030	Grain Vegetable and fruit	2910	Leather and fur products	3602	Machine tool and metalworking
2040		[(except wearing		machinery
2040	Sea food preserved		apparel)	3603	Industrial machinery
2050	Grain mill products	3112	Basic organic	3604	General industrial
2060	Bread and confec-		industrial chemicals		machinery and equip-
	tionery products	3113	Synthetic dyestuff		ment
2092	Prepared feeds for	3114	Explosive compound	3605	Office machinery
	animal and poultry	3118	Chemical manure	3703	Other weak electrical
2140	Soft drinks	3119	Other basic industrial		appliances
2302	Cotton spinning		chemicals	3890	Other transport
2303	Wool spinning	3130	Paint, varnish and		equipments
2314	Woollen weaving		lacquer	3910	Scientific, measuring
2315	Hemp weaving	3192	Other chemical		and medical
2510	Wood milling		products		instruments
2520	Wooden products	3291	Miscellaneous coal		(including sanitary
2800	Printing and		products		goods)
	publishing	3414	Steel ingot		U = ,

TABLE 2A.	Industries with Intra-Industry Trade Index $-50 \sim 0 \sim +50$ in Japan
(In	fustries are grouped according to Induced Value Added Ratio)

of indirect input such as "transportation and retail." We estimated total value added required to produce one unit of output and called such amount as induced value added ratio.

Our system can be stated as follows;

(1) $[I - A]^{-1}F = X$ where X is total output vector A is input coefficient matrix F is final demand vector.

Total induced output required to produce an unit of output in j sector can be estimated by,

(2)
$$x_i^* = [i][I - A]^{-1}A_i$$

where A_j is *j*th raw vector of input coefficient matrix A.

[*i*] is $[1, 1 \dots 1]$ column vector of 1,

then x_j^* is induced output.

Equation (2) can take more general form,

(3)
$$X^* = [i][I - A]^{-1}A$$

Induced value added corresponding to induced output in (3) can be estimated by

(4)
$$V^* = [i][\hat{v}][I - A]^{-1}A$$

where $[\hat{v}]$ is a diagonal matrix of direct value added ratio,

0211	Nursery products and	2910	Leather and fur	3415	Hot-rolled steel
	conservation and		products	3417	Cold-finished and
	uncultivated forest		(except wearing		plated steel
	materials gathered		apparel)	3418	Iron and steel cast-
0410	Marine fishery	2930	Leather products		ings and forgings
	products		(except wearing	3422	Copper rollings
1101	Coal		apparel)	3423	Aluminium rollings
1400	Stone and quarrying	3111	Basic inorganic	3429	Other basic non-
2020	Dairy products		industrial chemicals		ferrous metal
2050	Grain mill products	3112	Basic organic		products
2060	Bread and confec-		industrial chemicals	3501	Structural metal
	tionery products	3114	Explosive compound		products
2070	Sugar	3115	Rayon material	3605	Office machinery
2092	Prepared feeds for	3116	Synthetic fiber	3606	Household machinery
	animal and poultry		material	3607	General machine parts
2110	Liquor and alcoholic	3117	Plastic	3701	Strong electrical
	drinks	3119	Other basic industrial		machinery
2200	Tobacco		chemicals	3702	Household electrical
2305	Ravon spinning	3191	Medicine		appliances
2306	Synthetic fiber	3192	Other chemical	3703	Other weak electrical
	spinning		products		appliances
2312	Cotton and spun	3210	Petroleum refinery	3810	Ship and its repairing
	ravon weaving	<u>}</u>	products (including	3850	Motorcycle and bicycle
2313	Synthetic fiber		grease and lubricating	3860	Aircraft
	weaving		oil)	3890	Other transport
2315	Hemp weaving	3292	Miscellaneous antisep-		equipments
2320	Knit		ticized materials	3920	Photographic and
2330	Rope and fish net	3310	Structural clay		optical instruments
2390	Other fiber products		products		(including photo-
2410	Footwear (except	3320	Glass and glass		graphic sensitive
	rubber footwear)		products		materials)
2440	Made-up textile goods	3330	Pottery, china and	3930	Watch and clock
	(except wearing		earthenware	3990	Miscellaneous
	apparel)	3340	Cement		industrial products
2520	Wooden products	3390	Other non-metallic	8300	Business services
2600	Furniture and fixture		mineral products	8400	Recreation services
2720	Paper articles	3412	Iron scrap		
2800	Printing and publishing	3414	Steel ingot		

TABLE 2B. INDUSTRIES WITH INTRA-INDUSTRY TRADE INDEX $-50 \sim 0 \sim +50$ in West Germany (Industries are grouped according to Induced Value Added Radio)

$$[\hat{v}] = \begin{bmatrix} v_1 & 0 \\ 0 & v_n \end{bmatrix}.$$

In Fig. 3 and 4, we rank the industries according to induced value added ratio assuming that high value added ratio corresponds to fabricated high processed goods. Industries with low value added ratio are assumed to produce intermediate goods and goods at early stage of fabrication. We used 1970 trade data for Japan and West Germany and calculated $E_j / \sum_{j=1}^{n} E_j$ (export ratio), $M_j / \sum_{j=1}^{n} M_j$ (import

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ratio) and $(E_j - M_j)/(E_j + M_j) \times 100$ (intra-industry trade index) for each industry.

In both countries, high export ratio was concentrated in industries with high induced value added ratio. Thus we may conclude that Japan and West Germany, both countries having large domestic market export high processed goods. However there is a marked difference in distribution of import ratio in two countries. While high import ratios in Japan are concentrated in low processed intermediate and raw materials, there is no observed difference between import ratio of high processed goods and low processed goods in West Germany. As a result of such difference in import ratio of Japan and West Germany, intra-industry trade index falls between $-50 \sim +50$ in 31 industries in case of the former against 67 industries in case of the latter.

Table 2 lists industries where intra-industry trade index fall between $-50 \sim +50$. 67 industries in West Germany include various type of industries. They include consumer goods industries-bread and confectionary, dairy products, intermediate goods industries-chemical fiber, cement, and capital goods industries-office machinery, ships and vessels. 31 industries in Japan include such industries as food and textile where imports are increasing rapidly reflecting recent rise in wages and fall in price competitiveness, machinery industries where export started to expand reflecting technological advance in the 1960's. In both countries intra-industry trade was not limited to differentiated final products that style or quality difference seem important. There was substantial intra-industry trade transactions in standardized intermediate goods.

It became obvious from Table 2A and 2B that there is more intra-industry transactions in West Germany than in Japan. Such difference reflected the difference in import ratios in two countries. Import ratios ware generally higher in various types of industries in West Germany compared to those in Japan.

III

Conclusions

1) We found that Japan with domestic market size approximately similar to West Germany tends to specialize and export high processed products than low processed intermediate products. If we assume that high processed products correspond to differentiated commodities and low processed products to standardized commodities, Japanese trade structure can be characterized by exports of differentiated commodities.

2) Intra-industry trade is often related to product differentiation. Namely that country will export and import products that belong to the same industry but differ in style, design or quality. However our study shows that intra-industry trade is not limited to differentiated products but also observed in intermediate standardized products.

3) As for intra-industry trade index, inter-country difference between West Germany and Japan was much greater than inter-commodity difference. In West

Germany, intra-industry trade indexes of 67 industries in total of 160 industries ranged betwen $-50 \sim +50$. There were only 31 industries that ranged between $-50 \sim +50$ in case of Japan. Japanese industries in Table 2 were either industries that were facing increase in imports as their competitive positions were weakening, or experiencing increase in exports as their competitive postitions were strengthening.

4) Difference in intra-industry trade pattern between West Germany and Japan may be due to formation of EEC and trade liberalization policy undertaken by West Germany. In West Germany, lowering of import duties and lifting of other trade barriers date back to mid-1950's. However in case of Japan, major objectives of trade policy till 1970's were to expand exports and curb imports. Especially imports of manufactured goods were discouraged to provide necessary employment opportunities in labor intensive consumer goods industry and to assure domestic market for so-called "infant-industries." After the rapid liberalization policy in 1971 and 1972, there is a gradual increase in manufactured imports.

5) In case of West Germany, early liberalization policy and mutaual tariff reduction of EEC may have led to specialization in particular processes and type of products. Whether intra-industry trade in West Germany is more pronounce in trade with EEC member countries or also observed in trade with other developed countries is yet to be analysed. But as Balassa has pointed out, trade liberalization seems to be very important factor in intra-industry trade.

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Code	Name of Sector	Code	Name of Sector	Code	Name of Sector
0111	Grain		products	2070	Sugar
0112	Other field crop and	0420	Whale	2091	Other food prepared
	vegetable except for	0430	Inland water fishery	2092	Prepared feeds for
	industrial process		products		animal and poultry
0113	Fruit	1101	Coal	2110	Liquor and alcoholic
0114	Field crop for	1102	Lignite		drinks
	non-fiber industrial	1210	Iron ore	2140	Soft drinks
	process	1220	Non-ferrous metal ore	2200	Tobacco
0115	Field crop for fiber	1301	Crude petroleum	2301	Silk reeling and
	industrial process	1302	Natural gas		waste silk spinning
0116	Livestock breeding	1400	Stone quarrying	2302	Cotton spinning
	except for fiber	1910	Salt quarrying	2303	Wool spinning
0117	Livestock breeding for	1990	Other non-metal ore	2304	Hemp spinning
	fiber		mining and quarrying	2305	Rayon spinning
0118	Sericulture	2011	Carcass and meat	2306	Synthetic fiber
0120	Agricultural servies		prepared		spinning
0211	Nursery products and	2012	Meat preserved	2311	Silk and rayon
	conservation and	2020	Dairy products		weaving
	uncultivated forest	2030	Vegetable and fruit	2312	Cotton and spun
	materials gathered		preserved		rayon weaving
0212	Charcoal and firewood	2040	Sea food preserved	2313	Synthetic fiber
0220	Log	2050	Grain mill products		weaving
0300	Hunting	2060	Bread and confec-	2314	Woollen weaving
0410	Marine fishery		tionery products	2315	Hemp weaving

APPENDIX I.	Aggrigated Sector	CLASSIFICATION ($(160 \times 160 \text{ Sector})$
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Code	Name of Sector	Code	Name of Sector	Code	Name of Sector
2316	Yarn and fabric	3192	Other chemical	3606	Household machinery
	dyeing and finishing		products	3607	General machine parts
	(entrusted processing	3210	Petroleum refinery	3701	Strong electrical
	only)		products (including		machinery
2320	Knit		grease and lubricating	3702	Household electrical
2330	Rope and fish net		oil)		appliances
2390	Other fiber products	3291	Miscellaneous coal	3703	Other weak electrical
2410	Footwear (except		products		appliances
	rubber footwear)	3292	Miscellaneous anti-	3810	Ship and its repairing
2430	Wearing apparel		septicized materials	3820	Railroad equipment
	(except footwear)	3310	Structural clay	3830	Motor vehicle
2440	Made-up textile goods		products	3840	Motor vehicle
	(except wearing	3320	Glass and glass		repairing
	apparel)		products	3850	Motorcycle and
2510	Wood milling	3330	Pottery, china and	2000	bicycle
2520	Wooden products		earthenware	3860	Aircraft
2600	Furniture and fixture	3340	Cement	3890	Other transport
2711	Pulp	3390	Other non-metallic	2010	equipments
2712	Paper	0411	mineral products	3910	Scientific, measuring
2720	Paper articles	3411	Pig iron		and medical instru-
2800	Printing and	3412	Iron scrap		ments (menuding
	publishing	3413	Ferro alloy	3020	Samary goods) Photographic and
2910	Leather and fur	3414	Steel ingot	3920	ontical instruments
	products (except	3413 2416	Steel nine and tube		(including photo-
••••	wearing apparel)	2410	Steel pipe and tube		granhic sensitive
2930	Leather products	5417	plated steel		materials)
	(except wearing	2/18	Iron and steel cast-	3930	Watch and clock
2000	apparer) Bubbon products	5410	ings and forgings	3990	Miscellaneous
2111	Rubber products	3421	Non-ferrous metal		industrial products
5111	industrial chemicals	5421	materials	4001	New residential
2112	Pasic organic	3422	Copper rollings		building construction
5112	industrial chemicals	3423	Aluminium rollings	4002	New non-residential
3113	Synthetic dyestuff	3429	Other basic non-		building construction
3114	Explosive compound		ferrous metal products	4003	Building repairing
3115	Rayon material	3501	Structural metal	4004	Public utility
3116	Synthetic fiber		products		construction
	material	3502	Other metal products	4009	Other construction
3117	Plastic	3601	Prime mover	5110	Electric power supply
3118	Chemical manure	3602	Machine tool and		(including privately
3119	Other basic		metalworking		generated power)
	industrial chemicals		machinery	5120	Gas supply and
3120	Vegetable and animal	3603	Industrial machinery		distribution
	oil and fat	3604	General industrial	5200	Water supply and
3130	Paint, varnish and		machinery and		sanitary services
	lacquer		equipment	6110	wnoiesale trade
3191	Medicine	3605	Office machinery	6120	Ketall trade

Appendex I. Continued

Code	Name of Sector	Code	e Name of Sector	Code	Name of Sector
6200 6300	Financial business Insurance business	7150	facility services Ocean transport	8300	services Business services
6401 6402 6403	Real estate agency House rents Real estate rents	7160 7170 7100	Coastal and inland water transport Air transport	8400 8501	Recreation services Drinking and eating places` Other personal
7110	National railway transport Local railway and tramway transport	7200	services Storage facility services	8509 8600 8700	services Office supplies Packing materials
7122	Road passenger transport	7300 8100	Communication Government service	8800	Research institutes (governmental)
7141	Road freight transport	8210 8220	Education service Health service	9000	Activities not adequately described
7142	Road transport	8290	Other community		

Appendex I. Continued



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goods while low rank will indi transaction. ** See Appendix I. with no trade



Fig. 3. Export Ratio (1/10,000) by Process of Production in JAPAN and in West Germany (by Induced value added ratio)

* Industries are ranked according to the level of induced value added ratio, assuming that high ratio corresponds to highly fabricated goods while low ratio corresponds to intermediate goods and raw materials. Missing number shows industry with no trade transaction. ** see Appendix I.

Fig. 4. Import Ratio (1/10,000) by Process of Production in JAPAN and in West Germany (by Induced value added ratio)



* Industries are ranked according to the level of induced value added ratio, assuming that high ratio corresponds to highly fabricated goods while low ratio carreponds to intermediate goods and raw materials, Missing number shows industry with no trade transaction.

** see Appendix I.