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FACTOR ENDOWMENT CHANGE AND THE STRUCTURE OF COMPARATIVE ADVANTAGE : THE CASE OF JAPAN, 1956-1969

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Using a Leontieff-type analysis, this paper considers the impact of the rapid change in Japan's factor endowment after 1956 on the structure of its comparative advantage in international trade. Exports and imports have been disaggregated by region and degree of development of Japan's trade partners in order to evaluate the persistence of dualism in Japan's trade structure. The results indicate that the disappearance of abundant labor has eroded Japan's comparative advantage in labor intensive goods and caused a convergence in the commodity structure of Japan's exports to developed and underdeveloped economies. Labor-saving technological bias has further accentuated the capital intensification of Japan's export structure.

Factor Endowment Change and Structure of Comparative Advantage: The Case of Japan, 1956 - 1969*

INTRODUCTION

It has long been recognized that a country's relative factor endowment will strongly influence the focus of its comparative advantage in international trade. Within the context of the postwar Japanese economy, this paper will consider the impact of a rapid change in its factor endowment on the structure of its comparative advantage. Several questions will be addressed. In 1954, Japan was a "labor-abundant" economy[1], midway in the factor endowment spectrum between the developed (MDCs) and less developed (LDCs) economies. A dualism in its economy and trade structure prevailed. Has the rapid erosion of its labor abundance affected the technological character of its trade? What was the role of the export structure in this development process: was it a leading sector or did it change in concert with the changing structure of production? As Japan's factor endowment has converged toward that of the MDCs, has the dualism in its trade structure been similarly eroded?

In section I, we shall briefly describe the structure of Japan's economy during the period, and the change that occurred in its factor endowment. Section II will discuss the Leontief methodology used in evaluating the technology of a trade bundle, and some of the index number problems that arise when this methodology is applied in a dynamic context. In parts A and B of section III, the change in the technology of exports over the period is examined, particularly in relation to the simultaneous evolution in the structure of production. In part C, these results are linked to the underlying shift in the commodity composition of exports. In part D, we go beyond the simple dichotomy of exports to the LDCs and MDCs, and evaluate whether the simple "neo-factor proportions" theory can be empirically generalized to a multi-country world. Specifically, does the ranking by technology of Japan's exports to a set of

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[1] We will use the term "labor-abundant" to signify an economy characterized by easy labor market, tight credit conditions, with a high proportion of workers in low marginal productivity occupations. The term "labor-surplus" is often associated with many theoretical constructs of questionable applicability to Japan at this time, and has been avoided.

countries directly correlate with their respective levels of economic development? In section IV, part A, we examine the technological change in Japan's import structure, and the overall change in Japan's comparative advantage. In part B, we address the issue of whether Japan's export structure was allocatively efficient.

I. SETTING

In many respects, Japan provides an interesting case study for the analysis of these issues. Within the last two decades, it has evolved from a battle-torn, moderately-developed economy to the third largest economy in the world and its economic growth rate far outpaces that of other developed (MDC) and less developed countries (LDC). This structural transformation in its production structure has been accompanied by a striking shift in its factor endowment position. Rapid rates of capital formation and demographic restraint led to the disappearance of "easy labor market conditions" in the factor markets by the early 1960s, and Japan's factor endowment position has rapidly converged toward a capital-abundant position characteristic of the MDCs. Has Japan's comparative advantage in trade similarly shifted toward the more capital-intensive sectors of its economy?

In the mid-1950s, Japan's factor endowment position was midway between the MDCs and LDCs. Its low per capita income and labor-abundant factor market placed its capital-labor endowment below the former; large inflows of American aid and high domestic savings rates supported a capital infrastructure surpassing that of most LDCs. Japan's historical emphasis on education, and its receptiveness to foreign technology suggests a labor force rich in human capital endowment relative to most LDCs and some MDCs.[1]

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[1] These assertions can be easily substantiated. For example, Japan's capital-labor endowment (fixed capital per employee) and skill endowment (skilled employees as a percentage of the labor force) in 1974 were dominated by Canada, U.S.A., Austria, Belgium, France, Germany, Netherlands, Norway, Australia, and Israel, while Japan dominated Italy, Portugal, Spain, Mexico, Hong Kong, Korea, Pakistan, and Taiwan. A similar correspondence exists for these variables and GDP per capita. See Gary C. Hufbauer, "The Impact of National Characteristics and Technology on the Commodity Composition of Trade in Manufactured Goods," in Vernon, The Technology Factor in International Trade (NBER).

Japan's labor-abundant conditions were a critical support for its dualistic production structure in the 1950s. It allowed a dichotomy between the factor price ratios facing the large and small firm sectors of the economy. Although the small firms found capital relatively inaccessible, reflecting government priorities, the wage rates of their employees were also considerably below the rates paid in the large-scale enterprises of any given sector.[1] This dualism in factor-price ratios was mirrored by a technological dualism within any sector. Labor-intensive and capital-intensive firms coexisted within sectors. Government support enabled the large capital-intensive sectors to survive and develop. At the same time, the labor-intensive sectors -- the traditional source of Japan's international competitiveness -- were constrained by the unavailability of capital to maintain this labor-intensive technology focus. This dualism in industrial structure extended to Japan's trade structure. Tatemoto and Ichimura's study of Japan's 1951 trade structure[2] reveals that it clearly exported capital intensively to the LDCs and labor intensively to the MDCs.

As the labor market tightened in the early 1960s, the viability of this industrial dualism was eroded.[3] Wage differentials began to narrow, as wage rate increases in the small firm sector outpaced that of the larger firms, without, however, any substantial lessening in the differential accessibility to the capital markets. The ability of the small firms to remain competitive in world markets in the export of labor-intensive commodities was threatened. Do we find a shift in Japan's comparative advantage toward the relatively

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[1] Broadbridge, Seymour, Industrial Dualism in Japan (Chicago: Aldine Pub.Co. 1966).

[2] This was initially observed by Tatemoto, M. and Ichimura, S., "Factor Proportions and Foreign Trade: The Case of Japan," Review of Economics and Statistics, November, 1959.

[3] For further discussion of the character and impact of the factor endowment shift see (1) Economic Planning Agency, Government of Japan, Economic Survey of Japan: 1960/61; through 1965/66 (The Japan Times, Tokyo); (2) Mycohei Shinohare, "Patterns and Some Structural Changes in Japan's Postwar Industrial Growth" in Klein & Ohkawa, Economic Growth (Homewood, Ill., Irwin, 1968), pp. 278-303; (3) Seymour Broadbridge, Industrial Dualism in Japan (Chicago: Aldine Pub. Co. 1966).

capital-intensive sectors of its economy, or have the labor-intensive sectors continued to dominate exports, with only a shift in the capital intensity of the latter's production processes?

Moreover, since 1955, Japan's factor-endowment has converged toward that of the MDCs. Between 1955 and 1960, the aggregate capital-labor ratio in its economy rose at an annual rate of 6.72%, and this increased to 8.34% between 1960 and 1967. Its per capita income has also converged to MDC levels. Most of its LDC trading partners have not kept pace with this rate of growth, leading to an increasing divergence between their relative factor endowments. Although some of Japan's partners have grown rapidly (Taiwan and Philippines in particular), the continued high rates of labor force growth in the LDCs has more than kept pace with the rate of industrial growth.[1] Would this shift in Japan's relative factor endowment position bode a shift in both the commodity composition and the regional destination of its exports?

Any shift in Japan's import structure due to these trends would be also influenced by the gradual freeing of its restrictive policies towards imports. Tariff and non-tariff barriers were used to shield established, inefficient sectors, (particularly in agriculture and in the traditional consumption goods[2] sector) and to subsidize the development of many new industrial sectors. The effect was to bias the mix of imports towards goods for which import substitution was not yet viable, goods embodying new technological innovations, and raw materials necessary for industrial production. Consumption imports were restrained.[3] Substantial liberalization of these import barriers

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[1] For data on relative sectoral growth rates, see U.N., Industrial Development Survey, Vol. IV (New York: U.N.; 1972), pp. 59-113; 117; David Turnham, The Employment Problem in Less Developed Countries: A Review of Evidence (Paris: OECD, 1970).

[2] Prior to 1964, non-tariff and tariff barriers existed on a wide range of commodities, such as meat, spices, carbon black, chemicals (such as sulphuric nitric acid, crude benzoil, resins) cement, leather, perfumes, coffee, cocoa, butter, glass instruments, footwear, clothing, radios, sewing machines, motorcycles, vegetables, electric bulbs, binoculars, fish, office equipment, stoves, jewels, and musical instruments.

[3] On the other hand, some Japan specialists argue that at least prior to the late 1960s, Japanese consumers were biased toward traditional Japanese consumer goods, and thus that this market was primarily shielded by these behavioral factors. See K. Ohkawa and H. Rosovsky, "The Indigenous Components in the Modern Japanese Economy," Economic Development and Cultural Change Vol. 9, No. 3 (April 1961).

did not begin until 1964. As late as 1969 residual import restriction policies were still maintained on agricultural products, petroleum, coal and sulpher, bovine cattle leather and digital computers.[1]

II. METHODOLOGY

A well-defined procedure, initially developed by Leontief,[2] exists for measuring the technological characteristics associated with the production of a bundle of commodities. Applying a set of industry-specific factor coefficients to an input-output table of an economy, a measure of the direct and indirect requirements for labor, capital and skilled labor associated with the production of a unit of any industry's output can be obtained. To calculate the capital or skill intensity associated with a unit (i.e. one million yen) bundle of exports or imports, one simply weights these factor requirements by the relative shares of each industry in the given trade bundle.

For our analysis, we shall use the following notation. Let k^i_{xt} be the ratio of the capital to labor requirements, direct and indirect, associated with the production of a bundle of exports (x) in period t, using the technology of year i (similarly, k^i_{mt} connotes the same measures for imports). Let l^{60}_{xt} indicate the share of skilled workers in the labor force required to produce a bundle of the tth year exports, using the technology of 1960.

Our analysis relies on technology data for the Japanese economy in three years: 1955, 1960 and 1968. The sixty-sector input-output tables[3] and capital coefficients[4] corresponding to each period are deflated to 1960 prices. Esti-

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[1] Kiyoshi Kojima, "Non-tariff Barriers to Japan's Trade": Japan Economic Research Center, Discussion Paper No. 16 (December 1971).

[2] W. Leontief, "Domestic Production and Foreign Trade: the American Capital Position Reexamined," Economia Internationale, Vol. VII, No. 1 (Feb 1954) pp. 3-32.

[3] The 1968 table was a "projected" table prepared by Japan's Economic Plannings Agency. Although we subsequently received the 1965 table, it was expressed at a 56 sectoral level, and this presented several difficulties in that there was not a one to one relationship between the 60 and 50 sector tables with respect to SITC trade categories.

[4] The capital coefficients were available only on a twenty sector basis and although these have been matched with the corresponding industries in the 60 sector table, there is obviously a loss in accuracy. The data also have not been corrected for the level of capacity utilization in any given year. We did not attempt to derive capital coefficients from the annual investment and depreciation statistics of the Kogyo Tokei Hyo (Census of Manufactures) since: 1) The capital coefficients for 1955 and 1960 would have been based upon extremely poor and non-comparable

mates of output per employed laborer and per skilled worker respectively, in each of the 60 sectors were obtained from Economic Planning Agency (EPA) and Census Department statistics, respectively. Our skill coefficient is the proportion of professional and technical workers employed in each sector's labor force.[1]

Statistics on the commodity composition and destination of trade flows are derived from the commodity trade statistics (series D) of the United Nations. Each SITC category is imputed to a sector in the input-output table. All Japanese exports are assumed "competitive"; for imports, we exclude primary commodity imports (such as agricultural commodities, and industrial non-processed raw materials[2]), since these are industries for which Japan has only limited production capacity or potential due to its meager natural resource base. This effectively excludes a significant fraction of Japan's total imports, particularly from the less developed world.[2,3] All trade flows were deflated to 1960 prices.[4]

The interpretation of the estimated factor intensity of Japan's export and import structure over the period is subject to obvious index-number difficulties. Specifically, any change in the computed technology character-

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statistics since the quality of the data has improved considerably over the last 15 years; (2) an accurate linkage between the sectors of the Kogyo Tokei Hyo, and of the input-output tables for the manufacturing sectors would be quite difficult since the Kogyo Tokei Hyo statistics are on an establishment rather than product basis; and (3) we still would have lacked data for the non-manufacturing sectors.

[1] These coefficients were only available for 1960.

[2] For example, in 1963, Japan's imports of SITC commodity classes 0-4 were 75% of its total imports, 63.5% of its imports from the MDCs, 94% of its imports from the LDCx. In 1969, these statistics had fallen slightly to 69.8%, 57.5% and 86%, respectively.

[3] It could be argued that our inclusion of "indirect" factor requirements biases the results in that the high proportion of raw materials imported imputes a factor bias which is unrepresentative of its actual production structure. In fact, the results obtained do not significantly differ when only the direct factor requirements of a given trade bundle are calculated.

[4] The deflators were supplied by the EPA and the Bank of Japan. Export price deflators could not be disaggregated to more than six sectors, whereas import deflators are available for each sector.

teristics may reflect changes in one or more of the following: (1) the relative factor and commodity price structure, (2) the inter-industrial production structure, (3) the industry-specific factor coefficients and (4) the commodity mix of trade. We have removed one source of variation by our deflation of all data to 1960 prices.

The relative influence of each of the remaining factors may be examined by holding the others constant. For example, shifts in the factor-intensity of Japan's exports over time which arise strictly from changes in the export bundle's composition can be estimated by holding the technology constant, that is, by using the input-output table and factor coefficients of a given year (1960) in the analysis of each year's exports. Alternatively, we could evaluate a given year's trade bundle by the technologies of different years.

There are several problems with this partial approach. First, in the constant technology case, an examination of the technology of export bundles of alternative years could yield theoretically ambiguous results according to the particular base year technology chosen. For example, applying the 1960 technology, we might find that Japan's economy in this period had been such as to reverse the relative factor intensity of the industries exporting to Korea and the U.S.A. More likely, if the growth in capital intensity of the rapidly growing export sectors exceeded that in other sectors, use of a later year's technology would suggest a more extreme change in the capital intensity of exports arising from compositional changes in the export bundle.

Second, if one were to compare the technology of Japan's export bundles to an LDC and to an MDC over time, one would expect that by holding the technology constant, any differences would be biased downward. This problem arises because the structure of exports is influenced by shifts in the factor endowment structure. For example, the increase in the capital and skill intensity of production in Japan should be reflected by a capital intensive shift of the composition of its export bundles. Those export bundles embodying the largest share of capital-intensive goods would be more capital-intensive, relative to other export bundles, using a 1968 technology, than with a 1960 technology.

Third, all our analysis is carried out in constant 1960 prices. This may distort our analysis in the opposite direction, but the degree of distortion (or even its direction) is not fully apparent without further

analysis.[1]

III. FACTOR ENDOWMENT CHANGE AND THE EXPORT STRUCTURE: 1956-1969

In this section, we shall examine whether the disappearance of the labor abundant economy is reflected in the technological character of Japan's exports from 1955 to 1968. Since Japan's import structure is so heavily biased toward non-competitive primary products, and because of the distortions engendered by its restrictive import policies, we shall discuss imports separately in section IV.

A. The Technological Characteristics of Exports: 1956-1969

In Table 1, we have presented the capital and skill intensity associated with the production of representative export bundles of Japan from 1955 to 1968. In part A, the capital-intensity measures are calculated using the own technology associated with each year's production process. The increase in the capital intensity of Japan's exports over the period is immediately apparent, rising from $1734 per man in 1955 to $5229 per man in 1968. This reflects both changes in the composition of the export bundles as well as the general increase in the capital and skill intensity of all production processes over the period. The effect of the former alone is shown in part B of Table 1, where we have held the technology constant to that prevailing in 1960. The increasing values of k_{xt}^{60} indicate a rising share of capital intensive sectors in the export bundles.[2]

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[1] For example, changes in the factor price ratio (P_L/P_K) would yield shifts in the technology utilized in any production process, in the relative prices observed for capital and labor intensive commodities, and in the resulting mix of production as between these classes of commodities. The bias arising from not incorporating these changes in prices would depend upon the elasticity of substitution as between factors of production in each sector, and the price elasticity of demand for these sectors in both domestic and world markets. For example, suppose an increase in P_L/P_K) between 1955 and 1968. If the elasticities of substitution in production are less than unity, the relative commodity prices of capital and labor intensive commodities would probably decline between 1955 and 1968 (assuming the demand elasticity for each commodity was not high). Deflation to 1960 dollars would lead to an overvaluation (undervaluation) of capital (labor) intensive goods in Japan's exports in the later periods.

[2] This does not reflect a decline in the absolute volume of labor-intensive commodities, but rather a rising share for the more capital-intensive sectors.

Table 1

The Capital and Skill Intensity of Japan's Exports and Imports: 1956 - 1968
(in 1960 prices)

Part A: In Current Year Technology: Capital Intensity (k^{i}_{xt})[a]
(in U.S. dollars)

Commodity Bundle	k^{55}_{55}	k^{60}_{60}	k^{60}_{63}	k^{68}_{68}
Total Exports	1734	2334	2594	5229
Total Exports to MDCs[c]	1522	2173	2441	5127
Total Exports to LDCs[d]	1867	2496	2679	5243

Part B: In Constant 1960 Technology: Capital Intensity (k^{60}_{xt}) and Skill Intensity (l^{60}_{xt})[b]
(in U.S. dollars)

Commodity Bundle \ Trade Year	1955	1960	1963	1968
		Capital Intensity		
Total Exports	2291	2334	2594	2831
Exports to MDCs	2024	2173	2441	2768
Exports to LDCs	2444	2496	2679	2841
Total Imports	2169	2425	2367	2624
Imports from MDCs	2290[c]	2561	2401	2663
Imports from LDCs	1759[c]	1967	2014	2106
		Skill Intensity		
Total Exports	2.56%	2.57%	3.00%	3.53%
Exports to MDCs	2.21%	2.38%	2.80%	3.50%
Exports to LDCs	2.70%	2.63%	3.11%	3.55%
Total Imports	2.77%	2.36%	2.47%	2.93%
Imports from MDCs	3.12%	2.66%	2.74%	3.16%
Imports from LDCs	1.72%	1.48%	1.71%	2.33%

[a] k^{i}_{xt} is the ratio of the direct and indirect capital requirements (in U.S. dollars) to the indirect and direct total labor requirements (in numbers of laborers) required to produce a unit bundle (in U.S. dollars) of exports of period t, using the technology of year i. k^{i}_{mt} is the equivalent measure for imports.

[b] l^{60}_{xt} is the ratio of the direct and indirect requirements of professional and technical workers to the direct and indirect total labor requirements (both in numbers of laborers) required to produce a unit bundle of exports of period t, using the technology of 1960. l^{60}_{mt} is the equivalent measure for imports.

[c] Where we assume that the k^{60}_{m60} and l^{60}_{m60} ratios for developed and less developed country imports to total imports, can be applied to 1956 imports.

[d] For developed countries, this includes all countries falling within the U.N. definition of a developed country for the purposes of the E1 category of the SITC statistics. For less developed, this includes all countries falling within the E2 category.

Table 2

The Relative Capital Factor Intensity of Trade Under Alternative Technologies

	$\frac{k^{55}_{x60}}{k^{55}_{x56}}$ a/	$\frac{k^{60}_{x60}}{k^{60}_{x56}}$	$\frac{k^{68}_{x60}}{k^{68}_{x56}}$	$\frac{k^{55}_{x68}}{k^{55}_{x56}}$	$\frac{k^{60}_{x68}}{k^{60}_{x56}}$	$\frac{k^{68}_{x68}}{k^{68}_{x56}}$	$\frac{k^{55}_{x68}}{k^{55}_{x60}}$	$\frac{k^{60}_{x68}}{k^{60}_{x60}}$	$\frac{k^{68}_{x68}}{k^{68}_{x60}}$
Total Exports	1.020	1.018	1.023	1.251	1.235	1.306	1.226	1.213	1.277
Exports to Developed Countries	1.066	1.074	1.074	1.406	1.367	1.472	1.319	1.273	1.370
Exports to Less Developed Countries	1.022	1.022	1.029	1.157	1.162	1.211	1.133	1.138	1.177

a/ where k^{55}_{x60} is the ratio of the direct and indirect capital requirements to the direct and indirect total labor requirements, using the 1955 technology for the export bundle of 1960.

Table 3

The Capital and Skill Intensity of Japanese Domestic Production and Final Demand: 1956 - 1968
(in 1960 prices and 1960 technology)

(in U.S. dollars)

Year / Commodity Bundle	k^{60}_{55}	k^{60}_{60}	k^{60}_{63}	k^{60}_{68}	l^{60}_{55}	l^{60}_{60}	l^{60}_{63}	l^{60}_{68}
In the Primary and Secondary Sectors								
(1) Gross Value Added	1836	2032	2161	2367	1.50%	1.98%	2.33%	2.75%
(2) Domestic Final Demand a/	1853	1966	2054	2111	1.48%	1.88%	2.12%	2.32%
(3) Private Consumption Demand	1709	1761	1803	1894	1.17%	1.32%	1.42%	1.65%
In the Secondary Sector (Manufacturing)								
(4) Gross Value Added	2498	2621	2654	2808	3.26%	3.57%	3.64%	3.88%
(5) Domestic Final Demand	1952	2108	2189	2266	1.69%	2.34%	2.46%	2.76%
(6) Private Consumption Demand	1792	1857	1915	2002	1.30%	1.51%	1.68%	1.97%

a/ Where Domestic Final Demand = (Consumption + Investment + Government Expenditures + Net Inventory Increases)

Source: Economic Planning Agency.

The technological dualism associated with exports to the developed and less developed world, initially noted by Tatemoto and Ichimura for trade in 1950, is also apparent throughout the period. Japan's exports to the LDCs are more capital and skill intensive than its exports to the MDCs. There is also a clear convergence in the technologies associated with Japa 's exports to the two blocs. Between 1956 and 1963, the gap between the k_x^{60} of each fell from $420 to $250; by 1969 it was less than $100. Two aspects c this convergence are worth noting. First, there is a strong difference in the rates of change in technologies associated with the export bundles to the LDCs and MDCs. Between 1956 and 1969, k_{xt}^{60} rose by 34% for the MDCs as compared with only 16% for the LDCs; similarly, the skill intensity l_{xt}^{60} rose 55% for exports to the MDCs, but only 31% for the LDCs. Secondly, the technology of exports to the MDCs is converging to the high initial (1956) levels of capital and skill intensity of exports to the LDCs. In fact, the latter were at least as capital-intensive as Japan's own imports from the MDCs.[1] Despite the import-substitution inspired impetus to the pre-1960 development of this capital-intensive sector, Japan was nevertheless able to compete with other MDCs in the sale of these goods to LDC markets.[2] The convergence process after 1960 indicates that this competitiveness was extended to MDC markets as well.

From Table 1, the growth in the skill intensity associated with these export bundles is markedly greater than that in their capital intensity. The compositional change in the trade bundle implied -- toward industries with high skill requirements relative to capital inputs -- is surprising. The stock of capital grows at a more rapid rate than the skilled labor force[3]-- 63% relative to 25% -- between 1960 and 1965. Hence one might have expected an increase in the relative price of skilled manpower relative to capital, which would increase the competitive advantage of firms that are capital rather than skill intensive. In this case, the compositional change would be

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[1] In 1956, the capital and skill intensities of these imports were $2290 per labor and 3.12% respectively. See Table 1.

[2] Its competitiveness may be explained by: (1) the willingness of Japanese producers to accept low profit margins on what was, at that time, a residual element in their total sales; (2) the export promotional incentives offered by the Japanese government, in addition to basic capital subsidies; (3) the newness of the capital plant structures in many LDCs, yielding great latitude as to the type of capital equipment purchased; (4) the newness of LDC markets.

[3] Economic Planning Agency: Input-Output Statistical Series; Census of Population, 1960, 1965.

the reverse. Our conflicting result may be an artifact that arises from holding constant the technology used in the analysis. With changes in technology included, it is possible that industries which in 1960 intensively used skilled labor relative to capital made the appropriate technological substitutions in subsequent periods. Changes in the structure of demand may explain this as well.

We earlier noted that the rate of technological change or of adjustment to changes in the factor price ratio may differ across industries over time. Any resulting changes in the relative factor intensity ranks of industries would then conceivably reverse the results obtained from comparing export bundles over time, with a fixed period technology. Were such reversals significant for the Japanese economy over the period, and do they undermine the basic thrust of our results?

Although changes in the ranking of sectors by capital-intensity are not unusual for the Japanese economy between 1956 and 1969, one does not observe extreme shifts in any particular sectors inter-industry ranking. For example, between 1960 and 1968, the capital intensity of the mining sectors increased particularly fast, and their sectoral ranking rose. The capital intensity of basic chemicals and steel in 1968 was 1.96 and 2.21 times higher, respectively, than their levels in 1960. Other products' capital intensity grew less rapidly, with lower such multiples. (The multiples for leather products, miscellaneous fabrics and spinning, and chemical fibres were only 1.80, 1.67, and 1.58, respectively.)

To test whether these reversals substantively modify our results, we compare (Table 2) the growth in the capital intensity of the export bundles of 1956, 1960 and 1968. For example, in Table 2, columns 1 to 3 measure the ratio of k^i_{x60} to k^i_{x56}, using each of the three different technologies. If the effect of technological change had been neutral across sectors, the ratios would be the same, regardless of technology period chosen.

For total exports between 1956 and 1960, the choice of technology year makes little difference to the revealed rate of change in their capital intensity. The convergence process of exports to the MDCs is more strongly indicated by the later period technologies, since the increase in their capital intensity between 1956 and 1960 rises from 6.6% to 7.4%. For the LDCs, the technological change over the period has virtually no impact on the rela-

tive factor intensity of exports in the two early periods.

Only after 1960, do we begin to observe the accelerated capital intensification of the economy, and in particular of the dominant export sectors of this later period. Reevaluating the exports of 1960 and 1968, using the 1968 technology, we see a sharp increase in the growth of their capital intensity over the period; for total exports, the increase is from 21.3% to 27.7%. The convergence process now is even clearer. For the LDCs, the increase is small -- from 13.8% to 17.7% -- since they were already importing from these capital intensive sectors in 1960. For the MDCs, the increase is more pronounced -- from 27.3% to 37.0%. The compositional shift in MDC imports from labor-intensive to capital-intensive goods is reinforced by more rapid capital-intensification in the production process of the latter goods. Therefore the choice of technology does affect the degree of change observed in the relative factor intensity of alternative export bundles; but the bias is as anticipated.

B. The Position of Exports in the Hierarchy of the Japanese Production Technology.

The shift in Japan's factor endowment over the period would theoretically imply an asymmetrical shift in the economy's production possibility frontier toward capital-intensive goods, and thus some compositional shift in Japan's export bundle solely on this account. Does the evolution of the export sector merely mirror this shift or does it also reflect Japan's increasing capital and skill intensity vis-a-vis its trading partners? Are the export sectors "typical" of the Japanese productive structure or did they represent an advanced or "leading" sector in Japan's economy?

To answer these questions, we compare the technologies associated with producing exports with those of alternative output vectors of the economy, specifically: (1) the gross value added in the non-services sector: agriculture, mining and manufacturing; (2) the gross value added in manufacturing, (3) aggregate domestic demand for manufactured goods -- the sum of consumption, government expenditure, investment and net inventory accumulation, (4) aggregate domestic demand in the non-services sector, and (5) private consumption in the non-services sector. A constant 1960 technology is used, and all goods are deflated to 1960 prices.

Several points emerge from these technology measures (Table 3) concerning the evolution of Japan's economy. First, the effect of combining production in the primary sector with that in manufacturing is to substantially lower the capital and skill intensity of the total commodity bundle. This is particularly striking in 1956; as the economy evolves, the declining relative importance of the primary goods sector is reflected in the rise in capital intensity of the total non-service sector. Again, this reflects the weakening factor-price support for the more labor-intensive sectors of the pre-1960 economy.

Second, the capital and skill intensity associated with domestic final demand for manufactured goods is relatively low throughout the period. This is not surprising, reflecting the high weight of private consumption demand for very labor-intensive manufactures. In fact, the capital intensity of the private consumption vector is below the capital intensity of the entire final demand vector. More surprising is the negligible compositional change of the final demand vector. Its capital intensity grew by only 12% over the period; the skill intensity grew more rapidly. The former supports the Rosovsky-Ohkawa observation of the durability of Japan's traditional consumption function.

Third, the convergence of Japan's export structure parallels the evolution of Japan's domestic production structure. The level and change in the technology of exports to the LDCs is similar to that of value added in the manufacturing sector alone. Until the mid-1960s, the LDCs imports were from the more advanced sectors of the Japanese economy. Japan's competitive advantage with the MDCs lay with exports from the long established consumption oriented sectors. These exports were only slightly more capital and skill intensive than the vector of Japan's domestic final demand vector. They were in sectors with long-established marketing channels to the West and whose competitiveness was firmly rooted in the labor surplus conditions of Japanese labor markets.

Finally, the growing capital and skill intensity of exports to the MDCs reflects a convergence, not only to the technology of exports to the LDCs, but to that of the manufacturing sector as well. It is Japan's trade with the MDCs that signals the international competitiveness of Japan in those capital-intensive sectors, ranging from steel to automobiles, that had been initially

Table 4

Capital and Skill Intensity Rankings of Japanese Production Sectors and Their Relation to the Factor Intensity of Japanese Exports: 1960(60) Technology

(using 1960 technology; in 1960 prices)

(in 1960 dollars)

Capital Intensity Ranking	k_n^{60}	l_n^{60} a/
1. Forestry & Logging	1293	10
2. Livestock for Textiles	1406	5
3. General Crops	1409	1
4. Other Livestock	1418	4
5. Fisheries	1421	9
6. Industrial Crops	1441	2
7. Wood Products	1443	18

Group I

	k_n^{60}	l_n^{60} a/
8. Grain Mill Products	1503	3
9. Slaughtering, Meat & Dairy Products	1623	8
10. Seafoods Manufacture	1647	17
11. Spinning, Natural Fibres	1696	6
12. Tobacco	1743	12
13. Furniture	1822	16
14. Leather & Leather Products	1841	7
15. Apparel	1888	13
16. Misc.Foods	1901	15
17. Misc.Fabrics	1983	11

Group II

	k_n^{60}	l_n^{60}	Exports and Gross Value Added in manufacturing in year: 1956	1960	1963	1968
18. Rubber Products	2005	14	MDC			
19. Beverages	2102	25				
20. Metal Products	2348	22	TOT	MDC, TOT		
21. Precision Instruments	2351	28				
22. Printing & Publishing	2510	42	LDC, GVA_m	LDC	MDC	
23. Miscellaneous Manufactures	2530	20				
24. Paper and Pulp	2726	19		GVA_m	TOT, LDC, GVA_m	
25. Coal Products	2746	32				
26. Petroleum Products	2768	41				
27. Ceramic, Store & Day Products	2802	23				MDC
28. Motor Vehicles	2807	27				GVA_m TOT, LDC

	k_n^{60}	l_n^{60}
29. Electrical Machinery	2972	37
30. Misc. Machinery	2981	38
31. Spinning Chemical Fibres	3033	21
32. Grease & Final Chemicals	3059	30
33. Mis.Transportation Machinery	3118	35

Group III

	k_n^{60}	l_n^{60}
34. Coal	3461	24
35. Misc. Mining	3871	29
36. Iron Ores	3582	26
37. Nonferrous Metallic Ores	3589	33
38. Crude Petroleum Natural Gas	3739	31
39. Nonferrous Metals	4447	34
40. Basic & Intermediate Chemicals	4465	36
41. Crude Steel	4506	40
42. Steel Casting & Forging Hot Rolled Steel	4882	39

a/ The ranking of each industry by skill intensity.

b/ the direct and indirect capital intensity in U.S. dollars per man of sector n.

promoted under an import-substitution strategy. It represents the convergence of Japan's real comparative advantage with the dynamic comparative advantage anticipated in the mid-1950s. The export sector moved from a position straddling the traditional and modern sectors of the economy, toward primary concentration on the latter. The traditional sector's position appears supported primarily by the durability of Japan's traditional preferences in final consumption.

C. Commodity Structure of Japanese Trade

We have seen that some of the observed change in the technology of the export bundles is attributable to the increasing share of the capital and skill intensive sectors. The commodity locus of this change is shown in Table 4, where we have ranked each of the forty-two primary and secondary sectors according to their capital intensity. The level of each industry's capital-labor ratio and its ranking by skill-intensity are both indicated. The 42 sectors have been divided into three groups. The range in the capital intensity associated with the Group II sectors has been chosen to fully encompass the range of variation in the capital intensity of Japan's exports to the MDCs and LDCs over the period. Group I sectors are less capital intensive; Group III sectors are more capital intensive.[1] The capital intensity of each export bundle is indicated by associating the bundle with the industrial sector of the same level of capital-intensity.

The increase in the capital intensity of these bundles is easily linked to the rise and decline of particular export sectors. For exports to MDCs, the share of three Group I sectors, (seafood processing, miscellaneous fabrics, and wood products) dropped sharply as a share of Japanese exports (37% in 1956, 27.40% in 1960, 17.5% in 1963, and 10% by 1967). Miscellaneous fabrics in particular, fell sharply from 29.5% of Japan's MDC exports in 1956

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[1] A further breakdown was attempted. We classified any sector as high or low in its capital intensity if it was above or below the mean capital intensity for the 42 production sectors; a similar dichotomy was made by skill intensity. By this criterion, industries tended to fall either within the extreme categories of high capital intensity, high skill intensity or low capital, low skill intensity. Surprisingly few sectors fell between these extremes.

to 9.3% in 1969. Only the apparel industry, which is relatively capital intensive among Group I industries, held its share at 9%. The growth sectors in exports to MDCs include steel casting and forging, basic and intermediate chemicals, miscellaneous transportation machinery and miscellaneous machinery, all of which are Group III sectors. Of these, the highly capital intensive steel and chemicals sectors rose from 5.5% in 1956, to 7.3% in 1960, to 20% in 1969. Motor vehicles rose from 5% in 1960 to 9.8% in 1969. Electrical and miscellaneous machinery rose from 4.7% in 1956, to 23.6% in 1969. Of Group II sectors, the automotive and electric machinery industries exhibited the most rapid growth in exports.

The sectoral shares of exports to the LDCs exhibit less structural change, which is indicative of the export capacity in capital intensive goods which had already been developed by the mid-1950s. For example, steel casting and chemicals were 11.5%, and miscellaneous machinery and "miscellaneous" transport machinery (vessels) were 24.6% of Japan's exports to the LDCs in 1956. Over the period, with the exception of large increases in the export shares of electrical machinery (2.5% in 1956 to 11.1% in 1969) and motor vehicles (.8% to 7.0%), the shares of other capital intensive sectors rose only moderately, and some, such as transport machinery, fell (17.1% to 12.3%). The sharpest decline in LDC export shares is in fabric products falling from 29.5% in 1956 to 9.9% in 1969. This reflects as much the development of LDC substitutes as the decline in Japan's competitiveness. Thus, Japan's comparative advantage in capital intensive exports to LDCs appears to have been reinforced by the changing factor endowment.

Finally, there is a clear "overlap" in the commodity bundles exported to the MDCs and LDCs, even in the labor surplus period of the 1950s. For example, miscellaneous fabrics and apparel were not only important components of Japan's exports to the MDCs, but accounted for a third of its exports to the LDCs. Such exports continue to be significant as late as 1969, when on a strict factor endowment basis, their competitiveness in LDC markets should have been excluded.[1] Similarly, Japan exported its capital-intensive goods to MDC markets as early as 1956, though none of these sectors loomed more

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[1] Since some of these markets are small, other potential competitors may not have made the investments in marketing channels necessary to compete effectively with Japanese producers.

than 4% of total exports. By 1960, however, steel casting and forging products were 9.6%, miscellaneous transport machinery 8.2%, and electrical machinery 7.4% of Japan's exports to the MDCs.

This overlapping would belie the dichotomous view of Japanese trade as espoused by Tatemoto and Ichimura. They argued that Japan would export capital intensive commodities to those above it in the spectrum of factor endowment ratios. By this view, one would not have hypothesized substantial export overlapping, particularly prior to 1963 when Japan's factor endowment position was in the middle of the spectrum. Thus a multi-commodity generalization of the "neo-factor proportions" theory[1] appears to hold, at the level of an LDC-MDC breakdown, for the factor intensity bias of the overall export bundles, but not for the individual commodities taken separately.[2]

D. A Generalization of Export Dualism to a Multi-Country Setting

The technological dualism of Japanese exports to the LDCs and MDCs has been clearly confirmed from our earlier results. Can we extend the dualism argument to a more disaggregated level? A simple hypothesis would be a direct relationship between the capital and skill intensity of the export bundle and the degree of development. The latter would reflect the factor endowment of the importing country or region. By this argument Japan's most capital intensive export bundle would be directed toward the least developed of the LDCs.

We disaggregated Japan's exports over the period on a regional basis and for a small number of countries.[3] (See Table 5) In general, the convergence pattern is reaffirmed on the disaggregated level. Exports to the developed country groupings have had a greater growth in capital intensity than exports to Latin America or other Asia. Likewise, with the exception of the

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[1] T. Lowinger (1972).

[2] A qualification to this argument is that we are examining aggregated commodity classes. Further disaggregation of trade by specific commodities or by their technological processes may lead to a reaffirmation of this theory.

[3] It should be noted that by volume, Japan's trade is principally focused on Asia, Europe, and North America. In 1956, exports to Asia equalled those to both America and Europe. By 1969, Asian exports were only 66% of the latter. On the other hand, in 1969, exports to Africa and South America were only $706 and $788 million respectively, as contrasted with $4311 million to the U.S., $1210 million to Europe, and $3865 million to Asia.

TABLE 5

The Capital and Skill Intensity of Japanese Exports by Region: 1956 - 1969

Regional Grouping of Country \ Year	$^{60}k_{xt}$ 1956	1960	1963	1967	1968-1969	$^{60}l_{xt}$ 1956	1960	1963	1968
Developed	2047	2174	2442	2672	2749	2.21%	2.38%	2.79%	3.50%
Underdeveloped	2444	2497	2697	2807	2840	2.69%	2.78%	3.10%	3.55%
Communist Bloc		3202	3264	3341	3441		3.73%	3.96%	3.81%
U.S.A.	1999	2199	2433	2729	2836	2.18%	2.49%	2.72%	3.47%
W. Europe	2102	2078	2373	2587	2800	2.20%	2.32%	2.96%	3.77%
Common Market	2194	2054	2518	2537	2800	3.23%	2.00%	2.85%	3.40%
European Free Trade Area	1955	1971	2257	2583	2702	1.91%	2.17%	2.84%	3.81%
China	2845	n.a.	3839	4029	4165	3.34%		4.33%	4.8 %
Other Asia	2408	2586	2818	2877	2836	2.50%	2.86%	3.37%	3.43%
HK & Singapore	2326	2242	2527	2527	2469	2.19%	2.19%	2.43%	2.56%
Malaysia	n.a.	2965	2789	3242	n.a.		5.07%	3.41%	4.39% a/
Latin America	n.a.	2726	2969	3021	3150		3.63%	3.69%	4.00% a/
Brazil	n.a.	2939	3739	3379	3396		4.53%	5.0 %	4.80% a/
Argentina	n.a.	3471	3459	3569	3850		4.28%	5.03%	4.94% a/
Subsaharan Africa	n.a.	2266	2405	2637	2726	1.72%	2.37%	2.81 %	3.67%

a/ 1967 Statistics

African countries, the various LDC groupings dominate in the relative capital and skill intensity of their imports from Japan.

However, there exists considerable variation not explained by our hypothesis. Within the LDC groupings, Japan's most capital intensive export bundles go to countries at opposite ends of the development spectrum -- Latin America (Brazil, Argentina) and China. For Latin America, one would have expected a trade bundle more similar to that of the developed countries. Equally paradoxical, exports to African countries are labor intensive, not skill intensive (particularly if one excludes Liberia[1]), and quite comparable in technology to the export bundles to the MDCs. The technology of exports to the Asian countries is midway between these groups, Thus, within the group of LDCs the factor intensity ranking of exports is the reverse of our hypothesis, with the principal exception of China.

Yet in a decade where many of the semi-developed LDCs were vigorously promoting import-substitution industrialization (ISI) policies, it is not surprising that what is essentially a static comparative advantage argument has only lukewarm results. The ISI policies of Latin America, China, and other Asian countries relied heavily on the importation of capital goods or intermediate raw materials through such measures as import licensing, foreign exchange controls, and tariff regimes biased in favor of capital goods. This ensured import bundles more capital intensive than would have been observed in a free market setting. For example, Argentina, Venezuela and Brazil import substantial quantities of steel products, miscellaneous and electric machinery. Virtually none of Latin American imports from Japan fall within the traditional Japanese export sector (i.e., miscellaneous fabrics and apparel). This structure is quite similar for the Asian LDCs, with greater emphasis on machinery and chemicals relative to steel.

Conversely, the African countries were less engaged in such actively promotive industrialization policies, particularly before the mid-1960s. Moreover, these countries had not developed a production capacity in many

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[1] Liberian imports from Japan have been quite high, and focused on miscellaneous transportation equipment. This reflects Japanese exports of ships, presumably registered under the Liberian flag, but which cannot be attributed to Liberia's factor endowment situation. In 1969, 91.4% of Japan's exports to Liberia fell within this category.

labor-intensive consumer goods. In most cases, this reflected the unavailability of certain factors of production -- entrepeneurial ability and skilled manpower.[1] Thus their import structure was heavily biased toward consumer goods for which the Japanese still had a comparative advantage. In 1956, 82.8% of Japanese exports to sub-Saharan Africa (excluding Liberia) were in miscellaneous fabrics (68%) and apparel (14.8%). An emerging African ISI policy is mirrored by the decline in the share of fabric imports to 31% and a rise in the share of apparel imports to 30.1% in 1969.

Contributing to the small share of capital goods exports to Africa, relative to Latin America or Asia was the lower potential volume of this trade. The costs of export promotion were probably too high relative to potential sales to justify development of this market. Only as Japan's international competitiveness in these goods was solidified in the late 1960s do we observe a vigorous effort toward export sales in Africa.

IV. ADDITIONAL OBSERVATIONS ON THE STRUCTURE OF JAPANESE TRADE: 1955 - 1969

Two subsidiary questions concerning the structure of Japanese trade can be evaluated through this methodology. First, our study has emphasized exports because the bulk of Japan's imports were "non-competitive" and the composition of the residual imports was subject to extensive government control and interference until the mid-1960s. Subject to these limitations, is there a technological dualism associated with Japan's "competitive" imports from the developed and less developed world? Secondly, was Japan allocatively efficient in its mix of exports over the period? Can we determine whether it was realizing the maximum gains from trade? We shall briefly examine these questions:

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[1] The low skill intensity of Japan's exports to Africa (particularly in the early period), would appear to counter this argument, but not if one sees these exports as supplying goods which are not domestically produced in any significant quantities.

Table 6

The Capital (δ_j^k) and Skill (δ_j^s) Intensity of Japan's Exports Relative to its Imports[a/]: 1956-1969

(in 1960 prices, and 1960 technology)

	1956	1960	1963	1967-1969
δ_j^k: Capital Intensity				
Total Trade	1.06	.96	1.10	1.07
Trade with Less Developed Countries	1.39	1.27	1.33	1.27
Trade with Developed Countries	.88	.85	1.02	1.02
δ_j^s: Skill Intensity				
Total Trade	.92	1.09	1.22	1.17
Trade with Less Developed Countries	1.57	1.78	1.82	1.45
Trade with Developed Countries	.71	.89	1.02	1.07

a/ $\delta_j^k = \frac{(k_{xt}^{60})_j}{(k_{mt}^{60})_j}$, $\delta_j^s = \frac{(l_{xt}^{60})_j}{(l_{mt}^{60})_j}$ where $(k_{xt}^{60})_j$ [$(k_{mt}^{60})_j$] is the capital intensity of exports (imports) to region j in period t, using the technology of 1960.

Table 7

Absolute Direct and Indirect Requirements for a Thousand Dollars of Exports Using Alternative Technologies: 1956-1968

(in 1960 prices)

Technology year / Year: trade bloc	1955 L[a/]	1955 K[b/]	1960 L	1960 K	1968 L	1968 K
Total exports 1956	1.587	2752	1.099	2517	.595	2378
to MDCs 1956	1.736	2643	1.242	2514	.692	2411
to LDCs 1956	1.519	2837	1.031	2520	.547	2372
Total exports 1960	1.531	2707	1.058	2469	.568	2326
to MDCs 1960	1.607	2609	1.132	2460	.616	2306
to LDCs 1960	1.460	2780	.991	2474	.523	2333
Total exports 1963	1.375	2725	.938	2434	.491	2306
to MDCs 1963	1.427	2654	.996	2431	.529	2301
to LDCs 1963	1.346	2767	.909	2436	.469	2313
Total exports 1968	1.253	2718	.829	2347	.424	2217
to MDCs 1968	1.250	2676	.839	2322	.431	2210
to LDCs 1968	1.266	2740	.825	2343	.419	2197

a/ Total units of labor required per thousand dollar unit of output.
b/ In U.S. dollars.

A. The Technology of Japan's Total Trade and Import Structure

Since Leontief published his "paradoxical" results concerning the trade structure of the United States, similar analyses for other countries have been made. Tatemoto and Ichimura's study of Japan's trade in 1950 found a similar paradox, but explained it by Japan's position midway in the factor endowment spectrum. Our results for Japan's "competitive" trade in 1956 bear out their observations.[1]

Specifically, let $\delta_j^k(\delta_j^s)$ measure the capital (skill) intensity of Japan's export bundle relative to its import bundle with a set of countries j. If δ_j^k (or δ_j^s) is more than 1, Japan's exports are more capital (skill) intensive than its imports. Our results (Table 6) suggest that (i) Japan's overall trade has been capital intensive throughout the period, and skill intensive since 1960; (ii) its trade with the LDCs is consistently more capital and skill intensive than its MDC trade since 1956 (viz. $\delta_{LDC}^k > \delta_{MDC}^k$, $\delta_{LDC}^k > \delta_{MDC}^s$), (iii) Japan has clearly traded capital and skill intensively with the LDCx ($\delta_{LDC}^k > 1$, $\delta_{LDC}^s > 1$); (iv) Japan's trade with the MDCs was labor and non-skill intensive ($\delta_{MDC}^k < 1$, $\delta_{MDC}^s < 1$) prior to 1963, and since then δ_{MDC}^s and δ_{MDC}^k are slightly above unity.

Although the dichotomy in the trade structure is clearly present, the dynamic change in this structure is only partly in line with our expectations. Given Japan's increasing capital and skill intensity in its factor endowment relative to other countries, we would expect the value of δ^k and δ^s to rise throughout the period. This is certainly true for δ^s. With δ^k it is true only for MDC trade. For total exports, δ^k is basically unchanged between 1956 and 1967/69, while δ_{LDC}^k falls (though it is still more than one.)

The LDC results are not surprising. Since only 14% of Japan's imports from the LDCs as late as 1969 were "competitive" (6% in 1963), the denominator of δ_{LDC} is based on a small volume of these imports. More narrow determinants of comparative advantage than factor endowment probably explain the imports (i.e. availability of processed agricultural products and industrial raw materials). Moreover, if Japan's exports to the LDCs were excessively capital

[1] The results in this section all assume a 1960 technology. All prices are again deflated to 1960 prices.

intensive relative to its factor endowment in the 1950s, then the slower growth in capital intensity in these exports is not unexpected; neither is the more rapid growth in the capital intensity of its imports.

The technological dualism in Japan's competitive import structure is the mirror image of its exports; Japan's imports from the MDCs are considerably more capital intensive and skill intensive than its imports from LDCs (Table 1) throughout the period.[1] Furthermore, the degree of labor intensity associated with imports from the LDCs is shown by comparison with our factor intensity measures for Japan's value added in the non-service sector and its vector of final demand. There is also a growing gap between the technology of Japan's production structure and that of its imports from LDCs.

B. The Allocative Efficiency of Japan's Export Structure

Let us assume Japan's export bundle in any period t is allocatively efficient, given the technology and factor prices of period t. This suggests that if one produced the unit export bundles of periods t, $t + i$, and $t - i$, with the technology of period t, the export bundle of period t would require the lowest amount of factors of production. The earlier and later period bundles should reflect the technology prevailing in their own periods, and thus should require a greater absolute amount of factors if produced in a different period t. Japan's exports in the earlier periods do not confirm this hypothesis.

In Table 7, we calculated the absolute labor and capital requirements associated with the production of the exports of 1956, 1960, and 1968, using each period's technology.[2] The inefficiency of the early period export bundles is apparent. Regardless of the technology year chosen, the lowest labor requirements are associated with the later export bundles. The capital requirements similarly decline for all bundles evaluated with the 1960 and 1968 technologies; with the 1955 technology, only the exports to the MDCs have higher capital requirements in the later years.

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[1] The size of this differential is probably understated. If the structure of Japan's pre-liberalization trade regime was, in fact, biased against capital intensive goods, particularly those for which Japan was developing a domestic production capacity, there is an underrepresentation of these goods in the observed import bundle. This would be particularly true for the imports from the MDCs.

[2] All data has been deflated to 1960 prices: trade bundles, input-output tables, and factor coefficients.

Japan's returns from its allocation of resources to the trade sector in 1955 and 1960 are thus less than optimum. The earlier period inefficiency primarily reflects an over-utilization of labor. The 1955 export bundles to the MDCs and LDCs require 28% and 17% more labor, respectively, than the exports for 1968, using the 1955 technology. It is also not surprising that only the LDC export bundle for 1955 appears extremely inefficient in its use of capital. Thus, alternative allocational options were available in 1955, but were taken advantage of only in later periods through 1) improved perception of the relative returns to exporting alternative commodities, 2) increased production capacity in the more profitable commodities, and 3) the development of export marketing channels. Conversely, the results suggest allocative efficiency for the later periods, at least in terms of the alternative export bundles of 1955, 1960 and 1963.

V. CONCLUSIONS

Two principal conclusions emerge from this analysis. First, the shift in Japan's factor endowment strongly altered its comparative advantage in trade. The composition of its export bundle shifted toward the capital intensive sectors, and shift was reinforced by a relatively larger deepening in the capital intensity of these sectors. Whatever viability had previously been attached to a dualism in Japan's export structure -- exporting capital intensively to the MDCs, labor intensively to the LDCs -- was deeply eroded by the disappearance of labor-abundant conditions in Japan's factor markets. The convergence in the technological characteristics of Japan's exports to the LDCs and MDCs suggests that the range of technologies for which Japan is internationally competitive has narrowed. It is primarily focused on capital and skill intensive sectors. Our analysis of the "gains from trade" also suggests that the change in the composition of the export bundle has been an efficient change, with a lower absolute resource cost associated with its production relative to alternative past bundles. Furthermore, it is noteworthy that Japan's export sector appears to be a leading sector in its growth path over the period. Even the technology associated with producing for final demand or for private consumption of manufactured goods is markedly more labor intensive than Japan's exports, even the subset of exports to the MDCs.

Secondly, our analysis reaffirms an earlier hypothesis that Japan, when it was midway in the factor endowment spectrum, would trade capital intensively with the LDCs and labor intensively with the MDCs. Japan's convergence to the factor endowment of the MDCs has eroded this dualism in its export structure, but not in its competitive import requirements. However, one cannot affirm the hypothesis that the relative labor-intensity of Japan's exports to a given country would be positively correlated with its degree of development. In fact, there is a parabolic character to the factor intensity structure of exports, the most capital intensive going to countries at a middle level of development, and the most labor intensive going to countries at the extreme ends of the development spectrum.

These results suggest that in countries where the relative factor endowment position is rapidly changing, industrialization policies predicated on a country's "dynamic comparative advantage" may not be totally unreasonable. However, the Japanese case also highlights the importance, during this import-substitution industrialization process, of continued promotion of exports from the established, internationally competitive, labor-intensive sectors. Equally relevant is the ability to render competitive the new industries themselves in international markets. Further research on the export promotion strategies of the Japanese are required.

REFERENCES

Blumenthal, Tuvia, "Exports and Economic Growth: The Case of Postwar Japan," Quarterly Journal of Economics, Vol. 86, No. 4 (Nov. 1972), pp. 617-731.

Broadbridge, Seymour, Industrial Dualism in Japan (Chicago: Aldine Publishing Co., 1966).

Hufbauer, G., "The Impact of National Characteristics and Technology on the Commodity Composition of Trade in Manufactured Goods," in R. Vernon, The Technology Factor in International Trade, (National Bureau of Economic Research, New York, 1971).

Japan, Government of, Bureau of Statistics, 1960 Population Census, of Japan, Vol. 2, Part 4.

Japan, Government of, Economic Planning Agency, Economic Survey of Japan, 1960/61 - 1969/70 (The Japan Times, Tokyo).

Japan, Government of, Economic Planning Agency, Input-Output Tables: 1960 1963, 1965, and 1968.

Japan, Government of, Economic Planning Agency, Input-Output Data Series for Planning Use, (May 1970).

Japan, Government of, Ministry of International Trade and Industry, Census of Manufactures, 1958-1967.

Kojima, K., "Structure of Comparative Advantage in Industrial Countries: A Verification of the Factor Proportions Theorem," Hitotsubashi Journal of Economics, (June 1970), pp. 2-29.

_____, "Nontariff Barriers to Japan's Trade," Japan Economic Research Discussion Paper No. 16, (December 1971).

Leontief, W., "Domestic Production and Foreign Trade: The American Capital Position Re-examined," Economia Internationale, Vol. VII, No. 1 (Feb 1954), pp. 3-32.

Lowinger, T., "The Neo-Factor Proportions Theory of International Trade: An Empirical Investigation," American Economic Review, 1972, pp. 675-681.

Naya, Seiji, "Natural Resources, Factor Mix and Factor Reversal in International Trade," American Economic Review, May 1967.

Ohkawa, K. and Rosovsky, H., "The Indigenous Components in the Modern Japanese Economy," Economic Development and Cultural Change, Vol. 9, No. 3 (April 1961).

Shinohara, Myohei, "Patterns and Some Structural Changes in Japan's Postwar Industrial Growth," in L. Klein and K. Ohkawa, Economic Growth, (Irwin, Homewood Illinois, 1968), pp. 278-303.

Tatemoto, M. and Ichimura, S., "Factor Proportions and Foreign Trade: The Care of Japan," Review of Economics and Statistics, (Nov 1959).

Turnham, David, The Employment Problem in Less Developed Countries: A Review of Evidence (Paris: O.E.C.D., 1970).

United Nations, Department of Economics and Social Affairs, Commodity Trade Statistics (Series D), 1956-1969.

United Nations, Industrial Development Survey, Vol. IV (New York: United Nations, 1972), pp. 59-117.