INDUSTRIAL STRUCTURE AND EMPLOYMENT

—The Experiences in Japanese Economic Development, 1955-68—

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INTRODUCTION

THE INDUSTRIAL structure is a complex system composed of and resulted from technical progress, changes in production and demand conditions, and patterns of foreign trade which have been achieved in the historical process of a specific country. Furthermore, the pattern of industrial development is largely dependent not only on the employment structure but also on the government's objectives and willingness to use various policy instruments for the purpose of economic development. Inversely, changes in the employment structure are affected by the pattern of industrial development promoted by the economic strategy chosen by the government. In this sense, these factors are mutually dependent.

This paper attempts to provide a comprehensive description of interrelations among patterns of industrial development, technological characteristics, the changes overtime in production and demand conditions, the effects of the government's industrial policies, and the employment structure, on the basis of the experiences of Japanese economy from 1955 to 1968.

The outline of this study is as follows:

(1) Statistical Determination of Technology Types:[1] First, given the classification of the whole economy into fifty-four sectors of the Japanese input-output table, the technology parameters of the production function for each sector were statistically determined using time-series data of labor and capital inputs and gross output. Second, all sectors were grouped into the following six technology types, in accordance with evaluation of the estimated value of these parameters.

(i) Type K(I-B) technology (large-quantity processing technology);
(ii) Type K(I-M) technology (large-scale assembly production technology);
(iii) Type K(II) technology (capital-intensive technology);
(iv) Type (L-K) technology (Cobb-Douglas constant earnings type);
(v) Type L(I) technology } (labor-intensive technology).
(vi) Type L(II) technology }

The author wishes to thank Professors Kōtarō Tsujimura and Keiichirō Obi for their helpful suggestions. Statistical assistances were provided by the economic research project at Keio Economic Observatory, Keio University. A part of the paper was presented to the Sixth International Conference of Input-Output Techniques, Vienna, 1974 [14], and it was further developed in connection with the research project at Keio Economic Observatory.

[1] Concerning the importance of technological progress on the structural change, see Leontief [11] [12] and Carter [1] [3].

The most significant aspects of technology are the economies of scale represented typically in the types (i) and (ii), which play an important part in the process of Japanese economic development.[2]

(2) Technology Types and Resource Allocation:[3] The next step is to examine empirically the changes overtime in the distribution of labor and capital in the 1950s and 1960s, among the sectors with the above-determined technology types. In this period, a large part of capital investment was concentrated in the sectors with the technology K(I-B) and K(I-M) types which grew taking advantage of economies of scale, while a large proportion of labor has been absorbed in the L(I) and L(II) type sectors. On the other hand, a large decrease of labor in the (L-K) type sectors was discernible.

(3) Commodity Classification by End-Use Categories and Technology Type: The whole commodities are, then, divided into the following five groups: (a) consumer goods sectors, (b) capital goods sectors, (c) intermediate goods sectors, (d) raw material sectors, and (e) energy supply sectors. This division of commodities and their relation to the technology type is then examined. As a result, it was observed that large capital investment was concentrated in the basic intermediate goods sectors with K(I-B) type technology.

(4) Domestic Demand Created by Government Policy: Theoretically, the size of production of intermediate goods should be limited within the extent induced by the increase of final demand in an economic system. Nevertheless, in this period, the rate of expansion of the basic intermediate goods (iron and steel, petroleum refining products, etc.) was very high beyond the level required by the Japanese domestic consumption demand. It must be asked why such a high rate of growth of the sectors had been maintained through these periods in the Japanese economy. Here it is shown that the expansion of these basic intermediate goods production had been strongly supported by the demand created by the government's industrial policy concentrated in the period from 1955 to 1965.

(5) Export Structure: In order to know more about the make-up of the Japanese industrial structure, a comparison can be made of the export structure of West Germany. It is shown that, while the heavy industry ratio in the export structure is almost equal in the two countries, the technological characteristics of exported goods differ greatly.

(6) Industrial Structure and Employment: Finally, the effect of the development pattern of the Japanese industrial structure on employment structure is examined.[4] In conclusion, it is emphasized that: (i) in the aspect of industrial structure, the expansion of production in the sectors with K(I-B) and K(I-M) type technology, the sectors with smaller capacity to absorb labor, had proceeded excessively through the concentration of large amount of capital investment and (ii) a large part of labor was absorbed in the sectors with L(I) and L(II) type

[2] For an analysis of technical change in the American economy, see Carter [2].

[3] Concerning the analysis of resource allocation, see Chenery [5] [6].

[4] Concerning the importance of structural interdependency on economic analysis, see Leontief [11] and Ozaki and Ishida [15].

technology, the sectors which do not need large amount of investment. This trend has resulted in forming a peculiar type of industrial structure of the Japanese economy which has grown with incredible reliance on the sectors of basic intermediate goods.[5]

I. STATISTICAL DETERMINATION OF TECHNOLOGY TYPES

It is generally recognized that a marked tendency towards heavy industry is the main characteristic in Japanese industrial structure.[6] However, the conventional division between heavy industry and light industry, which has been often used by economists, seemed to be a rather arbitrary separation, because of the lack of the exact criterion of classification.[7]

In order to gain a better understanding of the heavy industrialization concept, therefore, it will be necessary first to estimate the technology parameters of production function for each sector and then to classify all sectors into groups according to an evaluation of the estimated values of these parameters. From this basis, it is then possible to find out what are the technological characteristics of that group, which is generally referred to as heavy industry sectors. The author has estimated statistically, in his earlier papers [13] [14], the technology parameters of production function for each sector corresponding to the classification of the Japanese input-output tables.[8]

Summarized, they are as follows:

First, the production functions that show technological characteristics in each sector are divided into the two following types for measurement.

$$L=\alpha_L X^{\beta L},\ K=\alpha_K X^{\beta K}. \quad \text{(Factor limitational type)} \qquad (1)$$

$$X=\alpha L^{\gamma L} K^{\gamma K}. \quad \text{(Cobb-Douglas type)} \qquad (2)$$

5 Concerning the K(I-B) and K(I-M) types of production function, see Chenery [4] and Ozaki [13].

6 For instance, *1975 Economic White Paper* published by the government says that the strong trend towards heavy industrialization developed in the latter part of the 1950s with the result that in 1970 the heavy industry ratio, both in production and in export, exceeded that of West Germany and the United States. (By 1970, heavy industry accounted for 63 per cent of total production and 77 per cent of exports for Japan, while in the United States this was 60 per cent and 75 per cent and in West Germany 56 per cent and 79 per cent.)

7 A more detailed examination shows that, even among nations with the same heavy industry ratio, there are marked structural differences in production, export, and employment. A comparison in these structural differences between West Germany and Japan will be made in Sections V and VI.

8 The input-output data used in this study is the Japanese input-output tables for the years 1955 [7], 1960 [8], 1965 [9], and 1970 [10] published by the Japanese government. These tables were aggregated to fifty-four sectors for the analysis of the coordinated data sets of labor and capital inputs, gross output, and exports and imports. The arrangement of the mutually compatible input-output tables and the reconstruction of the time-series data sets were performed through the joint research efforts of members of the Center for Economic Data Development and Research.

Here L stands for the quantity of labor input, K for capital input, X for production scale.

Formula (2) is commonly known as the Cobb-Douglas production function of the factor-substitutable type. This production function is said to have the character of increasing returns to scale, constant returns to scale, and diminishing returns to scale under conditions of

$$\gamma_L + \gamma_K \gtreqless 1 .$$

On the other hand, the production functions in formula (1) are usually said to be of the factor-limitational type. In a specific case, that is, when $\beta_L = 1$, $\beta_K = 1$, this function becomes the well-known Leontief type of production function. Depending on $\beta_L \lesseqgtr 1$ or $\beta_K \lesseqgtr 1$, the economies of scale or diseconomies of scale will affect the aspects of labor and capital input.

The technology parameters for all sectors of the economy (fifty-four sectors in the Japanese input-output table) are now estimated by applying formula (1) and formula (2). It is possible to separate sector groups depending on whether formula (1) or formula (2) is more applicable statistically. I shall refer the former as the K sectors while the latter as the L sectors.

If a detailed examination of the parameter value of production function in the two groups is made, it is then possible to put them into a number of smaller groups by selecting those with similar values. These are the six following groups: (a) K(I-B) type, (b) K(I-M) type, (c) K(II) type, (d) (L-K) type, (e) L(I) type, and (f) L(II) type. Table I shows which sector belongs to which technological group.

Looking at Table I, it becomes evident that the sector groups K(I) type including (A) and (B) have technological characteristics where the effects of economies of scale prevail vigorously in both labor and the capital input ($\beta_L < 1$, $\beta_K < 1$). Should conditions on the demand side be fulfilled, this industry production will keep on growing indefinitely as it seeks the highest profits, through expanding of the plant size with this type of technology.

A further examination of K(I) type technology shows that it consists of approximately two smaller groups with similar parameter values. The first of these can be called the K(I-B) type. This is a kind of technology where the value of elasticity β_L of the labor input is extremely small ($\beta_L \fallingdotseq$ about 0.2–0.3) and where the value of capital intensity ($\overline{K}/\overline{L}$) is large. This technology is commonly referred to as a large-sized equipment type industry. Because massive investment is required and the large size of equipment allows drastic labor saving, I would term it "large-quantity processing technology" (K [I-B] type). Typical examples are petrochemical and iron and steel industries.

The second is technology listed as (B) in Table I, or "large-scale assembly production technology." As in the previous case, this technology allows the pursuit of economies of scale from both labor and capital input aspects, but, compared to K(I-B) type, the value of the elasticity parameter β_L for labor input is slightly larger ($\beta_L \fallingdotseq 0.3$–$0.5$) while the value of capital intensity ($\overline{K}/\overline{L}$) is not as large as K(I-B) type. Tentatively calling it "large-scale assembly production

TABLE I

PRODUCTION TECHNOLOGY TYPES

(1) K type (capital-intensive technology)

K(I) type

(A) Large-Quantity Processing Technology: K(I-B) Type

Technology Type		Sector	(1) Production Function Parameters β_L $L=\alpha_L X^{\beta_L}$	(1) Production Function Parameters β_K $K=\alpha_K X^{\beta_K}$	(2) $\left(\frac{\bar{K}}{\bar{L}}\right)_j$ 1951–68 Average	Technological Characteristics
K(I-B)	1	Electric power supply	0.12	0.80	17.43	(i) Measuring formula:
K(I-B)	2	Gas & water supply	0.68	0.73	2.59	(1) $L=\alpha_L X^{\beta_L}$, $K=\alpha_K X^{\beta_K}$
K(I-B)	3	Petroleum refining products	0.27	0.65	14.76	(ii) Parameter characteristics:
K(I-B)	4	Basic organic chemicals	0.33	0.72	5.70	$\beta_L<1$, $\beta_K<1$
K(I-B)	5	Artificial fiber materials	0.10	0.84	3.89	(iii) Parameter value: $\beta_L \fallingdotseq 0.2$–$0.3$
K(I-B)	6	Iron and steel	0.30	0.80	3.86	(iv) Capital intensity: $(\overline{K/L})$ value is
K(I-B)	7	Nonferrous primary products	0.38	0.73	3.84	large (>3)

(B) Large-Scale Assembly Production Technology: K(I-M) Type

Technology Type		Sector	(1) Production Function Parameters β_L $L=\alpha_L X^{\beta_L}$	(1) Production Function Parameters β_K $K=\alpha_K X^{\beta_K}$	(2) $\left(\frac{\bar{K}}{\bar{L}}\right)_j$ 1951–68 Average	Technological Characteristics
K(I-M)	8	Ships & ship repairing	0.07	0.80	1.19	(i) Measuring formula:
K(I-M)	9	Motor vehicles	0.46	0.70	2.12	(1) $L=\alpha_L X^{\beta_L}$, $K=\alpha_K X^{\beta_K}$
K(I-M)	10	Machinery	0.52	0.88	0.62	(ii) Parameter characteristics:
K(I-M)	11	Electrical machinery	0.55	0.91	1.00	$\beta_L<1$, $\beta_K<1$
K(I-M)	12	Precision instruments	0.53	0.97	0.59	(iii) Parameter value: $\beta_L \fallingdotseq 0.3$–$0.5$
K(I-M)	13	Fiber spinning	0.26	0.59	2.07	(iv) Capital intensity: $(\overline{K/L})$ value is
K(I-M)	14	Beverages & alcoholic drinks	0.33	0.79	2.26	median (<3)

(1) K type — K(II) type

(C) Capital-Intensive Technology: K(II) Type

Technology Type		Sector	(1) Production Function Parameters β_L $L=\alpha_L X^{\beta_L}$	(1) Production Function Parameters β_K $K=\alpha_K X^{\beta_K}$	(2) $\left(\frac{\overline{K}}{\overline{L}}\right)_j$ 1951–68 Average	Technological Characteristics
K(II)	15	Paper	0.13	1.03	3.07	(i) Measuring formula:
K(II)	16	Pulp	−0.29	1.23	3.94	(1) $L=\alpha_L X^{\beta_L}$, $K=\alpha_K X^{\beta_K}$
K(II)	17	Cement	0.08	1.03	9.07	(ii) Parameter characteristics:
K(II)	18	Basic inorganic chemicals	0.04	1.01	2.71	$\beta_L<1$, $\beta_K>1$
K(II)	19	Chemical manure	−0.71	1.71	4.97	(iii) Parameter value: $\beta_L<1$
K(II)	20	Miscellaneous coal products	−0.09	1.67	1.50	(iv) Capital intensity: $(\overline{K}/\overline{L})$ value is
K(II)	21	Tobacco	0.18	2.30	1.83	large

(2) L type — (L-K) type

(D) Cobb-Douglas Constant Earnings Type: (L-K) Type

Technology Type		Sector	(1) β_0 $\frac{X}{L}=\alpha_0\left(\frac{K}{L}\right)^{\beta_0}$	(2) $\left(\frac{\overline{K}}{\overline{L}}\right)_j$ 1951–68 Average	Technological Characteristics
(L-K)	22	Agriculture, forestry, and fisheries	0.67	0.46	(i) Measuring formula:
(L-K)	23	Coal & lignite	0.56	0.90	(1) $X/L=\alpha_0(K/L)^{\beta_0}$
(L-K)	24	Mining	0.64	0.56	(ii) Parameter characteristics: simple and symmetrical
(L-K)	25	Silk reeling & spinning	0.70	0.59	(iii) Parameter value: $\beta_0>0.5$
(L-K)	26	Vegetable & animal oil & fat	0.69	1.91	(iv) Capital intensity: $(\overline{K}/\overline{L})$ value is
(L-K)	27	Wood milling	0.78	0.68	small (<1)

(2) L type (labor-intensive technology)

(E) Labor-Intensive Technology (Increasing Returns to Scale): Types L(I) and L(II)

	Technology Type		Sector	(1) $X=\alpha L^{\gamma_L}K^{\gamma_K}$ γ_L	γ_K	(2) $\left(\frac{\bar{K}}{\bar{L}}\right)_j$ 1951–68 Average	Technological Characteristics
L(I) type	L(I)	28	Building & construction	0.75	0.45	0.25	(i) Measuring formula: $X=\alpha L^{\gamma_L}K^{\gamma_K}$
	L(I)	29	Meat	0.44	0.61	1.52	
	L(I)	30	Seafood, preserved	0.90	0.48	0.59	(ii) Parameter characteristics: $\gamma_L+\gamma_K>1$
	L(I)	31	Transport services	0.70	0.67	1.04	
	L(I)	32	Paints	0.58	0.73	1.51	(iii) Parameter value: $\gamma_L<1$, $\gamma_K<1$
	L(I)	33	Rubber products	0.99	0.63	0.99	(iv) Capital intensity: $(\bar{K}/\bar{L})$ value is about 1
	L(I)	34	Glass products	0.44	0.88	1.46	
	L(I)	35	Miscellaneous industrial products	0.83	0.93	0.78	
L(II) type	L(II)	36	Other transport equipment	1.31	0.54	1.01	(i) Measuring formula: $X=\alpha L^{\gamma_L}K^{\gamma_K}$
	L(II)	37	Metal products	1.35	0.30	0.49	
	L(II)	38	Leather products	2.21	−0.07	0.40	(ii) Parameter characteristics: $\gamma_L+\gamma_K>1$
	L(II)	39	Furniture & fixtures	1.82	0.44	0.40	
	L(II)	40	Other wood products	2.33	0.68	0.26	(iii) Parameter value: $\gamma_L>1$, $\gamma_K<1$
	L(II)	41	Paper articles	1.29	0.56	0.72	
	L(II)	42	Pottery, china & earthenware	1.39	0.55	0.51	(iv) Capital intensity: $(\bar{K}/\bar{L})$ value is small (<1)
	L(II)	43	Structural clay products	1.59	0.96	0.57	
	L(II)	44	Other nonmetallic mineral products	1.87	0.19	1.15	
	L(II)	45	Medicine	1.20	0.80	1.25	
	L(II)	46	Weaving & other fiber products	1.75	0.63	0.79	
	L(II)	47	Footwear & wearing apparel	1.93	0.28	0.31	
	L(II)	48	Printing and publishing	1.43	0.27	0.57	
	L(II)	49	Other food, prepared	1.26	0.35	0.65	
	L(II)	50	Trading	1.95	0.84	0.65	
	L(II)	51	Finance & insurance	1.60	0.22	0.70	
	L(II)	52	Communication services	3.38	0.08	0.17	

technology," it includes most of the machinery sector.

Turning to K(II) type technology listed as (C), this is characterized by the fact that, while economies of scale ($\beta_L<1$) have a strong effect in the labor input process, in the case of capital inputs the diseconomies of scale ($\beta_K>1$) prevail and the value of capital intensity ($\overline{K}/\overline{L}$) is comparatively large. As a result, in times when wages are relatively increasing, there is a strong trend to economize labor by increase in capital investment. Traditional intermediate goods sectors such as pulp, cement, inorganic chemical, chemical fertilizer, and coal product industries are included in this group.

Therefore, the above are collectively termed (A) K(I-B), (B) K(I-M), and (C) K(II) groups of capital-intensive type (K type) technology.

In opposition to these three groups, there is another group which has a labor-intensive (L type) technology. The production function here is statistically approximated by the formula (2), the ordinary type of generalized Cobb-Douglas function. Among these is the (D) (L-K) type in Table I, which is the following linear-homogeneous Cobb-Douglas function.

$$X=\alpha_0 L^{1-\beta_0} K^{\beta_0},$$

or

$$\frac{X}{L}=\alpha_0\left(\frac{K}{L}\right)^{\beta_0}, \quad 0<\beta_0<1. \tag{3}$$

Primary industries, centering on agriculture, are included in this category.

Last are the L(I) and L(II) labor-intensive type technologies. They are approximated by the ordinary type of generalized Cobb-Douglas function with the characteristics of increasing returns to scale and factor substitutability ($\gamma_L+\gamma_K>1$). Type L(II) technology is the special case of $\gamma_L>1$ in L(I) type.

In both L(I) and L(II) type groups, the degree of capital intensity is low, while labor absorption ability is high. The (D) (L-K), (E) L(I), and (F) L(II) types are collectively termed labor-intensive technology (L type) (see Table I).

Table I shows what technological features in each sector are associated with which technology types. What role did these technological features play in the process of perpetuating Japan's heavy type industrial structure?

II. TECHNOLOGICAL CHARACTERISTICS AND CHANGES IN RESOURCE ALLOCATION

Table II gives the changes overtime in the distribution of labor and capital in each sector in the late 1950s and 1960s, in connection with the above technology types.

Column 2 in Table II shows how capital was largely concentrated during this period in sector groups with K(I) type technology: technology for large-scale assembly production, K(I-M) type, and large-quantity processing technology, K(I-B) type (27.9 per cent in 1955, 35.4 per cent in 1968). On the other hand, labor force was sharply reduced in the sectors centered on agriculture of (L-K)

TABLE II

TECHNOLOGY TYPE AND PERCENTAGE CHANGES OVERTIME IN THE COMPOSITION RATIOS FOR LABOR FORCE, CAPITAL STOCK, GROSS OUTPUT, AND EXPORTS, 1955–68

(%)

Composition Ratio / Technology Type	(1) Labor Force Composition Ratio		(2) Capital Stock Composition Ratio		(3) Gross Output Composition Ratio		(4) Export Composition Ratio	
	1955	1968	1955	1968	1955	1968	1955	1968
K(I)	7.1	13.1	27.9	35.4	17.9	34.0	28.5	63.4
K (I-B)	2.3	3.3	18.8	22.9	8.6	14.8	13.4	20.0
K (I-M)	4.8	9.8	9.1	12.5	9.3	19.2	15.1	43.4
K (II)	1.0	0.8	3.1	4.2	4.5	3.6	3.9	3.4
(L-K)	52.2	27.3	30.9	19.7	27.0	8.6	11.8	2.4
L (I) +L(II)	39.7	58.3	38.1	38.2	44.8	49.9	55.9	30.9
(Unclassified)		(0.5)		(2.5)	(5.8)	(3.9)		
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: The total (100 per cent) for each column shows the total amount of all sectors, except for the following two sectors: sector 53, real estate and rents, and sector 54, miscellaneous manufacturing and other business and personal services. For these two sectors, it was impossible to statistically determine the type of technology, due to the lack of capital stock data.

type technology (52.2 per cent in 1955, 27.3 per cent in 1968). In contrast, a large absorption of the labor force took place in sectors with L type technology, L(I) and L(II) types in Table II (39.7 per cent in 1955, 58.3 per cent in 1968).

During this period, the formula for distribution of capital and labor resources assumed a single linear pattern at surprising speed as capital went to sectors with K type technology and labor went to those of L type.

As a result of these changes in distribution of resources, gross output in terms of 1965 constant prices grew quickly in K type sectors (changes in the composition ratio were from 17.9 per cent in 1955 to 34.0 per cent in 1968), while there were comparative decreases in (L-K) sector (see column 3 in Table II: changes in composition ratio are from 27.0 per cent in 1955 to 8.6 per cent in 1968). At the same time, as column 4 shows, there were large increases of K(I) type goods (steel, petrochemical products, shipbuilding, automobiles, electrical machinery, etc.) in the composition ratio of total exports.

This indicates that in this period the pattern of resource allocation in the Japanese economy showed a concentration of capital in the K(I) type sector. There was a resultant expansion in production potential with accompanying strengthening of international competitiveness based upon the pursuit of merits of scale.

In other words, the high growth of the Japanese economy in the 1950s and 1960s was realized from a technical point of view by maximum utilization of the economies of scale, while, structurally, it resulted from a concentration of capital in the K(I) sector and expansion of production supply.

TABLE III
RELATIONSHIP BETWEEN COMMODITY GROUPS CLASSIFIED BY END-USE CATEGORIES AND TECHNOLOGY TYPES

Technology Type / Commodity Groups	Labor–Intensive Technology L(I) + L(II) Types	Large-Quantity Processing and Large-Scale Assembly Production Type Technology K(I) Type	Capital-Intensive Technology K(II) Type	Cobb-Douglas Type Technology (L-K) Type
(1) Consumer goods (including tertiary industries)	L(I) 29 Meat L(I) 30 Seafood, preserved L(I) 31 Transport services L(I) 32 Paints L(I) 33 Rubber products L(I) 34 Glass products L(I) 35 Miscellaneous industrial products L(II) 37 Metal products L(II) 38 Leather products L(II) 39 Furniture & fixtures L(II) 40 Other wood products L(II) 41 Paper articles L(II) 42 Pottery, china & earthenware L(II) 45 Medicine L(II) 46 Weaving & other fiber products L(II) 47 Footwear & wearing apparel L(II) 48 Printing & publishing L(II) 49 Other food, prepared L(II) 50 Trading L(II) 51 Finance & insurance L(II) 52 Communication services	K(I) 14 Beverages & alcoholic drinks	K(II) 21 Tobacco	

(2) Capital goods (including housing construction)		L(I) 28 Building & construction L(II) 36 Other transport equipment	(i) Large-Scale Assembly Production Technology K(I-M) 8 Ships & ship repairing K(I-M) 9 Motor vehicles K(I-M) 10 Machinery K(I-M) 11 Electrical machinery K(I-M) 12 Precision instruments	← Heavy Industry and Chemical Sectors = (i) + (ii) + (iii)	
(3) Intermediate goods	Other intermediate products	L(II) 43 Structural clay products L(II) 44 Other nonmetallic mineral products	K(I) 13 Fiber spinning.		(L-K)25 Silk reeling & spinning (L-K)26 Vegetable & animal oil & fat (L-K)27 Wood milling
	Basic intermediate goods		(ii) Large-Quantity Processing Technology K(I-B) 3 Petroleum refining products K(I-B) 4 Basic organic chemicals K(I-B) 5 Artificial fiber materials K(I-B) 6 Iron & steel K(I-B) 7 Nonferrous metal products	(iii) Capital-Intensive Type Technology K(II) 15 Paper K(II) 16 Pulp K(II) 17 Cement K(II) 18 Basic inorganic chemicals K(II) 19 Chemical manure K(II) 20 Miscellaneous coal products	
(4) Raw materials					(L-K)22 Agriculture, forestry & fisheries (L-K)23 Coal & lignite (L-K)24 Mining
(5) Energy supply			K(I-B) 1 Electric power supply K(I-B) 2 Gas & water supply		

Notes: 1. Technology types have been classified according to the evaluation of production function of each sector.
2. Commodity groups were classified according to the ratio of intermediate demand to final demand in the Japanese input-output tables [7] [8] [9] [10].
3. Capital goods generally relate to the machinery sector but comprise construction and public works. Automobiles and electrical machinery comprise durable consumer products but for purposes of comparison with West Germany have been included in capital goods.

III. RELATIONS BETWEEN TECHNOLOGY TYPE AND COMMODITY GROUPS CLASSIFIED BY END-USE CATEGORIES

However, economic development cannot be achieved solely from the supply aspect by technological pursuit of economy of scale. If there was monotonous expansion in supply capacity from 1955 to 1970, there must have been a corresponding change in the demand structure during that period.

What was the demand structure like that supported this distribution of resources and leaned heavily upon large-scale technology of the K(I) type?

In order to find out, the following analytical steps are taken. Demand structure does not necessarily directly correspond to technological characteristics. Therefore, industrial sectors shall be classified into a number of groups on the basis of demand characteristics. We shall then compare with those arranged according to technological characteristics and commodity classification by end-use categories based upon those of demand.

Conditions of Supply	→Type of Technology; Commodity Classification by End-Use Categories ←	Conditions of Demand

Classifying each industrial sector in the Japanese industrial structure according to the commodity classification by end-use categories, the five following groups are derived. (The method used is a calculation of the size of the median demand ratio for each sector, using the input-output table, and weighing each item according to final demand.) (1) Consumer goods sector, (2) capital goods sector, (3) intermediate goods sector, (4) raw materials sector, and (5) energy supply sector.

Table III shows the relationship between these commodity groups classified by end-use categories (conditions of demand side) and the technology types (conditions of supply side).

In this table, a clear correspondence between the industrial classification and technology types can be observed. With few exceptions, the greater part of the consumer goods sector relies on labor-intensive technologies of the L(I) and L(II) types, while the capital goods sector is dominated by the K(I-M) type (large-scale assembly production type) technology.

The intermediate goods sector, especially that for basic intermediate goods, corresponds to large-quantity processing technology, K(I-B) type, and capital-intensive technology, K(II) type. The raw materials sector applies (L-K) type technology—chiefly, agriculture and mining—and the energy supply sector, consisting of electric power, gas, and water supply, corresponds to K(I) type technology.

It was stated earlier that the term "heavy industry sector" was analytically vague, but the depiction in Table III should make the content clearer to a considerable extent. The characteristics of the concept "heavy industry sector" can be summarized as having the two following general peculiarities. Technologically, they (a) require a huge capital investment and (b) are capable of raising productivity through the expansion of production scale. Judged according to these standards, the so-called heavy industry sector is a collective term for the heavy-border portion of Table III which includes the capital goods sector, K(I-M) type technology, and basic intermediate goods sector, K(I-B) and K(II) technologies.

IV. DEMAND CREATED BY INDUSTRIAL POLICY

The high growth of heavy industry characterizing postwar Japanese economic development had its start in the latter 1950s. The period from the end of the war up to about 1955 was one of recovery for the economy, during which it returned to prewar levels. The *1956 Economic White Paper* said in effect that the postwar period was at an end.

During this period, the basic intermediate goods sector, with such industries as steel, chemicals, and nonferrous metals expanded rapidly.

Table IV shows the changes in the composition ratio of investment in each sector to total investment (in terms of 1965 constant price). In this table, it can be observed that the share of investment for the sectors of transport, communications, electric power, and commerce were large for all periods. The former three sectors constitute the economic infrastructure which will require massive investment. On the other hand, in the sector of commerce, the large size of this sector, while absorbing a large amount of labor force, developing a vast distribution sector encompassing all sectors, would have been in need of the large amount of capital investment.

Now turning to the examination of the manufacturing industry sector alone, the following interesting facts emerge. In the first period, 1952 to 1954, the economy began to expand due to Korean War spending. In this period, cotton spinning led, followed by steel, coal, electrical machinery, weaving and other textiles, and pulp and paper. These were leading sectors for the period.

In the second, third, and fourth rapid growth periods after 1955, iron and steel took the lead in the share of growing investment followed by electrical machinery, automobile, and organic chemistry industries, while investments in cotton spinning and textiles decreased rapidly.

Cotton spinning, weaving and textiles, pulp and paper, and inorganic chemistry were basic industries in the first period, but do not appear in the top-ten of the fourth period. In contrast, iron and steel maintain a top position from the second period on. The base for actual distribution of capital stock in heavy industry was established in the ten years of the second and third periods, i.e., in the late 1950s and 1960s. It is also clear that the 30 per cent nominal growth rate in investment of these periods was mostly in large-scale industries such as steel, machinery, organic chemistry, cement, and pulp.

As a result of this high level of investment accumulation in heavy industry, the industrial structure developed its present tendency of large-scale processing as shown by 130 million ton steel per year production capacity and 4 million ton per year capacity of petrochemical industry measured with ethylene as a standard.

TABLE
EVOLUTION OF THE GROSS INVESTMENT

Rank	First Period (1952–54 Average)		Second Period (1955–59 Average)	
1	(Transportation and communications)	(12.75)	(Transportation and communications)	(19.80)
2	(Electric power)	(11.45)	(Electric power)	(9.00)
3	(Commerce)	(6.55)	Iron and steel	7.11
4	Cotton spinning	3.79	(Commerce)	(6.76)
5	(Banking and insurance)	(3.72)	Electrical machinery	3.75
6	Iron and steel	3.46	Inorganic chemistry	2.97
7	Coal and lignite	2.94	Pulp and paper	2.40
8	Electrical machinery	2.74	Ceramics and quarrying	2.27
9	Weaving	2.41	Automobiles	2.23
10	Pulp and paper	2.33	Cotton spinning	2.11
11	Inorganic chemistry	2.28	Organic chemistry	1.93
12	Ceramics and quarrying	2.25	(Banking and insurance)	(1.84)
13	Nonferrous primary goods	1.64	Synthetic fiber material	1.83

Note: Average of gross investment composition ratio by sectors for the four periods from the Japan Data Development Center. Those items within parentheses do not belong to the

However, these are essentially intermediate goods sectors representing only induced demand. In other words, the size of this sector should be limited within the extent induced by the increase of final demand. Nevertheless, in this period, the rate of expansion of the investment in these sectors was very high. The high rate of Japanese economic growth has been brought about by this concentration of plant and machinery investment into the intermediate goods sector and ensuing increase in supply capacity. Why was it possible for these sectors to continue expanding demand over such a long period?

In this respect, it should be emphasized that industrial planning was carried out by the government in a concentrated fashion between 1955 and 1965 principally through land development policies which materialized in the construction of roads, harbors, railways, industrial cities, etc. making possible a long-term expansion of demand.

Table V is an outline history of government economic plans and enactment of the Economic Development Law from the mid-1950s to the mid-1960s. A Law for the Comprehensive Development of National Territory was enacted in 1950 and a ten-year plan based on it was announced in the following year. These economic policies were essentially reconstruction programs.

The situation changed from 1955 onwards as a number of land development projects were launched in rapid succession. These were programs requiring large-scale investment in: (a) urban planning, (b) area development, (c) coastal industrial zones, (d) development of large-scale transportation networks such as motor-expressways and high-speed railroad lines like the New Tokaido Line, (e) large-scale public works to improve roads and harbors.

IV
COMPOSITION RATIO BY PERIODS

Third Period (1960–64 Average)		Fouth Period (1965–69 Average)	
(Electric power)	(9.04)	(Commerce)	(10.50)
(Commerce)	(8.45)	(Transportation and communications)	(8.41)
Iron and steel	8.42	(Electric power)	(6.53)
(Transportation and communications)	(7.95)	Iron and steel	6.33
Electrical machinery	4.49	Automobiles	4.92
Automobiles	4.33	Construction	4.53
Construction	3.75	Electrical machinery	3.74
Organic chemistry	3.51	Organic chemistry	3.49
(Banking and insurance)	(2.98)	Nonferrous primary goods	3.30
General machinery	2.76	General machinery	2.74
(Real estate)	(2.61)	(Banking and insurance)	(2.43)
Ceramics and quarrying	2.55	Ceramics and quarrying	2.30
Pulp and paper	2.33	Metal products	2.03

1952 to 1969. Gross investment data based on chronological data for forty sectors from manufacturing industry sector.

TABLE V
EVOLUTION OF PROJECTS FOR NATIONAL DEVELOPMENT

Year Month	Industrial and Economic Policies	Land Development Projects
1954 Apr.	Basic Plan for the Development of Sources of Electric Power	
Apr.	5-year Shipbuilding Plan	
Oct.	3-year Plan for New Cement Plants	
1955 June	5-year Plan for the Development of the Petrochemical Industry	
Dec.	5-year Plan for Economic Independence	
1956 Jan.	10-year Plan for the Modernization of Electric Power Facilities	Sakuma Dam completed
Mar.	Japan Highway Corporation Law	
Apr.	Capital Zone Equipment Law	
June	Industrial Water Supply Law	
1957 Mar.	Law on Multipurpose Dams	Meishin Highway construction started
Mar.	Tōhoku Development Promotion Law	Hachirōgata Reclamation started
Apr.	Highspeed National Motorway Construction Law	Capital Highway construction started
Apr.	Law for the Construction of Motor Throughways for Land Development	
June	Aichi Water Supply Project	Aichi Water Supply Project started
Aug.	5-year Plan for Increased Transport Capacity by Private Railways	
Sept.	Housing Building Plan	
1958 Mar.	Law for Emergency Measures for Road Improvement	Kammon Highway Tunnel started

TABLE V (Continued)

Year Month	Industrial and Economic Policies	Land Development Projects
1958 Apr.	Basic Plan for the Equipment of the Capital Zone	
Sept.	5-year Harbor Plan	
Dec.	Plan for the Construction of the New Tokaido Line	
1959 Apr.	Capital Highway Corporation Law	New Tokaido Line construction started
Apr.	Kyūshū Development Law	
1960 Mar.	Industrial Zoning Law	
Dec.	Income Doubling Plan	
	Hokuriku Development Promotion Law	
	Chūgoku Development Promotion Law	
	Shikoku Development Promotion Law	
1961 Nov.	Law of the Industrialization of Low Developed Areas	Construction of Senriyama New Town started
Nov.	Water Resources Development Law	Niigata Pipeline installed
1962 Apr.	Law for the Development of Mining Districts	
May	New Industrial Cities Promotion Law	
May	Comprehensive National Development Law	
1963	"New Industrial Cities" designated	Kurobe Dam completed
	"Special Districts for Industrial Development" designated	
	Second Stage of Hokkaidō Comprehensive Plan put into effect	
July	Kinki Equipment Law	
	Law for the Development of New Residential Cities	
1964		Meishin Highway opened New Tokaido Line begins operation First stage of Equipment Plan for Tokyo International Airport completed Tokyo Olympics held Work begun on Kashima New Industrial Equipment Special District
1965	Mid-term Economic Program established	

The left-hand column of Table V shows that the enactment of various laws for the land development was begun around 1955 and virtually completed by 1965. These comprised, among others, the Japan Highway Corporation Law, the Capital (Tokyo) Zone Equipment Law, the Industrial Water Supply Law, the Law on Multipurpose Dams, the Capital Highway Corporation Law, the Water Resources Development Law, and the New Industrial Cities Promotion Law.

The right-hand column of Table V shows how, following the completion of the Sakuma Dam, large machinery was introduced to construct the Meishin (Nagoya-Kobe) Highway, the Hachirōgata Reclamation Project, the Capital highways, the New Tokaido Line, Aichi Water Supply, the Niigata Pipeline, and the Kammon (Shimonoseki-Moji) Highway Tunnel. At the same time, the construction of coastal industrial areas progressed, leading to the creation of large-scale complexes.

In sum, the series of projects for land development, drawn in quick succession between 1955 and 1966, rapidly expanded demand for products from the K(I) technology sector, chiefly iron and steel.

V. EXPORT STRUCTURE

Thus, the process of how capital investment was concentrated from the 1950s onwards in the K(I-B) technological sector and, as a result, an industrial structure generally referred to as a heavy industry type took shape in Japan. Is this heavy industry type structure akin to that of other advanced industrial nations or does it have definite Japanese characteristics?

To answer that, we shall look at differences in export structures since these are a direct reflection of the comparative technological advantage of industrial structures. For the sake of clarity, Japanese shall be compared with the West German export structure.

Table VI is a comparison of the composition ratio of export goods according to a four-digit classification level made by OECD in 1970, the time when Japan achieved maturity in the development of heavy industry. Study of this table shows that although Japan is said to have attained levels prevailing in America and Europe as a result of the rapid shift to heavy industry in production and export, a close examination of export goods reveals vast differences.

For instance, primary steel products occupy a dominating position in the ten leading Japanese export goods. If third-ranking cold-rolled and plate steel are added to hot-rolled steel (sixth) and steel pipes (tenth), it rises to 14.4 per cent, while with West Germany the ratio for the same products is only about 5.1 per cent.

As to machinery, household electrical appliances, automobiles, ships, industrial machinery, and light electrical machinery are 31.55 per cent of total exports for Japan, while they constitute 37 per cent for West Germany. In particular, while industrial machinery accounts for only 3.92 per cent for Japan, it is 19.28 per cent for Germany and is broken down as follows: industrial machinery 10.85 per cent, general industrial machinery and equipment 3.35 per cent, heavy electrical equipment 2.70 per cent, and machining and metalworking equipment 2.38 per cent.

This indicates that the international competitive position of Japanese machine industry is strong in shipbuilding, automobiles, and household electrical appliances, and that West Germany holds a comparative advantage in industrial machinery, particularly in machining and metalworking equipment for manufacturing, in addition to automobiles and electrical equipment. This tendency remains constant in the composition of the thirty leading goods for export with basic intermediate goods at 17.64 per cent for Japan, against a low 11.80 per cent for West Germany. On the other hand, machinery exports are 44.04 per cent for Japan and 48.30 per cent for West Germany. When shipbuilding is excluded, machinery exports register 36.79 per cent for Japan, against 47.41 per cent for West Germany. If only industrial machinery is taken into consideration, Japan stands at 9.81 per

TABLE
EXPORT COMPOSITION

Japan				
Technology Type and Number of Related Industrial Sector				Composition Ratio (%)
1	K(I-M)	3702	Household electrical appliances*	9.41
2	K(I-M)	3830	Automobiles*	7.68
3	K(I-B)	3417	Cold-rolled and plate steel†	7.54
4	K(I-M)	3810	Shipbuilding*	7.25
5	L(I)	3990	Other manufacturing industries	5.09
6	K(I-B)	3415	Hot-rolled steel†	4.40
7	K(I-M)	3603	Industrial machinery*	3.92
8	K(I-M)	3703	Other light electrical appliances*	3.29
9	K(I-B)	2313	Synthetic fiber woven textiles	3.25
10	K(I-B)	3416	Steel pipe†	2.45
11	L(II)	3850	Bicycles*	2.37
12	L(II)	3501	Metal construction materials	2.22
13	K(I-M)	3920	Optical instruments*	2.17
14	L(II)	2430	Wearing apparel and accessories	1.88
15	L(II)	3502	Other metal products	1.79
16	K(I-B)	3112	Basic organic chemicals†	1.71
17	K(I-M)	3701	Heavy electrical equipment*	1.69
18	K(I-M)	3605	Office equipment*	1.64
19	L(I)	3000	Rubber goods	1.59
20	K(I-B)	3116	Raw synthetic fiber material†	1.54
21	L(II)	2312	Cotton and synthetic fiber cloth	1.34
22	K(I-M)	3604	General industrial machinery and equipment*	1.32
23	L(II)	2320	Knitted goods	1.31
24	L(I)	2040	Seafood	1.25
25	K(I-M)	3607	Machine parts*	1.24
26	K(I-M)	3601	Power plants, boilers*	1.22
27	K(I-B)	3192	Other chemical products	1.19
28	L(II)	3330	Ceramics	1.11
29	K(I-M)	3606	Machinery for civilian use*	0.84
30		9000	Unclassified	0.78
			K(I-M)+K(I-B) type	60.50

Note: K(I-M) type, machinery; K(I-B) type, basic intermediate goods. Industrial sectors four-digit classification; asterisked industries are included in machinery sector and dagger-

cent against West Germany's much larger 26.32 per cent.

In summary, this means that the basic intermediate goods sector (mainly iron and steel) maintains a high ratio in Japan's export structure, while shipbuilding, automobiles, and electrical machinery also hold a large share, but machining and metalworking equipment do not command a relatively high position. In comparison, West Germany shows a high component ratio in exports for machinery and is competitive in industrial machinery and machining equipment.

VI
RATIO, 1970

Technology Type and Number of Related Industrial Sector			West Germany	Composition Ratio (%)
1	K(I-M)	3830	Automobiles*	13.79
2	K(I-M)	3603	Industrial machinery*	10.85
3	K(I-M)	3703	Other light electrical appliances*	3.96
4	K(I-M)	3604	General industrial machinery and equipment*	3.35
5	K(I-B)	3192	Other chemical products	3.01
6	K(I-B)	3417	Cold-rolled and plate steel†	2.82
7	L(I)	3990	Other manufacturing industries	2.73
8	K(I-M)	3701	Heavy electrical equipment*	2.70
9	K(I-M)	3602	Machining and metalworking equipment*	2.38
10	K(I-B)	3415	Hot-rolled steel†	2.31
11	K(I-M)	3607	Machine parts*	2.02
12	K(I-M)	3702	Machinery for civilian use*	2.02
13	L(II)	3501	Metal construction materials	1.99
14	K(I-B)	3112	Basic organic chemicals†	1.94
15	K(I-M)	3601	Power plants, boilers*	1.90
16	L(II)	3502	Other metal products	1.79
17	K(I-B)	3116	Raw synthetic fiber materials†	1.63
18	K(I-M)	3605	Office equipment*	1.56
19	K(I-M)	3910	Precision machinery*	1.56
20	K(I-B)	3416	Steel pipe†	1.56
21	K(I-B)	3119	Other basic chemicals†	1.54
22		9000	Unclassified	1.50
23	L(II)	3191	Pharmaceutical products	1.36
24	K(I-M)	3920	Optical instruments*	1.32
25	L(II)	2320	Knitted goods	1.09
26	K(I-B)	3421	Nonferrous base metals†	1.01
27	K(I-B)	3291	Coal products†	0.96
28	K(I-B)	3113	Synthetic dyes†	0.92
29	K(I-B)	3210	Petroleum products†	0.92
30	K(I-M)	3810	Shipbuilding*	0.89
			K(I-M)+K(I-B) type	66.92

are taken up to the thirtieth in top ranking according to the OECD data with SITC ed ones in intermediate goods sector.

In terms of technology, while Japan has a comparative advantage in basic intermediate goods such as iron and steel and organic chemicals with their large-quantity processing technology K(I-B) and in large-scale assembly production technology of automobiles, household electrical appliances, and shipbuilding, West Germany has an industrial structure that gives it international competitiveness in capital goods industries more than intermediate goods industries, including industrial machinery.

TABLE
EMPLOYMENT INDUCED BY UNIT OF

	(A) Total			(B) Direct Employment by the Sector		
	(1) Japan (Persons)	(2) West Germany (Persons)	(3) Japan/ W. Germany Multiplier Ratio	(4) Japan (Persons)	(5) West Germany (Persons)	(6) Japan/ W. Germany Multiplier Ratio
Chemicals	3,172	2,342	*1.35*	1,004	1,247	0.81
Nonferrous metals	2,350	1,782	*1.32*	855	896	0.95
Machinery	4,352	3,221	*1.35*	1,700	2,071	0.82
Automobiles (incl. repairs)	3,983	2,659	*1.50*	1,246	1,485	0.84
Other transportation machinery	3,910	3,339	*1.17*	1,318	1,859	0.71
Electrical machinery	4,548	3,514	*1.29*	1,913	2,457	0.78
Precision machinery	5,494	3,927	*1.40*	2,943	2,956	1.00
Other metal products	5,698	3,224	*1.77*	3,045	2,050	1.49
Iron and steel	1,802	2,333	0.77	316	1,098	0.29
Steel primary	2,437	3,723	0.65	602	2,654	0.23

Notes: 1. Column (3) shows that the total employment induced by ¥10 billion production is larger in almost all Japanese industries except for steel and primary steel products.
2. Column (6) shows that, on the contrary, the employment induced in the same sector is smaller in Japan, indicating that labor productivity in key industries is higher in Japan.
3. Column (9) shows that in contrast to the above description the employment induced by the indirect sector is overwhelmingly larger in Japan. Column (12) shows that among these indirect sectors the multiplier ratio of the distribution sector (commerce and transportation) is particularly high. This indicates an excessive expansion of the distribution sector in the Japanese employment structure.
4. Columns (13) and (14) show that the ratio of direct/indirect employment is larger in Japan. In Japan, the majority of these ratios is larger than 1 while in West Germany it is smaller than 1.
5. Method of calculation:

Even if the same value in heavy industrialization ratio is computed for both countries, the structure of each will differ considerably depending on the relative importance of K(I-M) or K(I-B) technological sectors. In this way, West Germany has acquired strong comparative advantage in the capital goods sector, K(I-M) technology, while Japan has obtained a strong international competitiveness in the basic intermediate goods sector, in particular for sectors with K(I-B) type technology such as iron and steel. In this manner, Japan's heavy industry industrialization has been characterized by an excessive expansion in basic intermediate goods with K(I-B) type large-quantity processing technology.

VI. INDUSTRIAL STRUCTURE AND EMPLOYMENT

How was the employment structure affected in the Japanese economy led by basic intermediate goods sector, K(I-B) type? As stated previously, the axis of eco-

VII

PRODUCTION IN KEY SECTORS, 1970

(Per ¥10 billion computed according to exchange rate)

(C) Indirect Employment by the Other Sectors			(D) Commerce and Transportation			(E) Direct/Indirect Multiplier Ratio	
(7) Japan (Persons)	(8) West Germany (Persons)	(9) Japan/ W. Germany Multiplier Ratio	(10) Japan (Persons)	(11) West Germany (Persons)	(12) Japan/ W. Germany Multiplier Ratio	(13) Direct/ Indirect Japan	(14) Direct/ Indirect W. Germany
2,168	1,095	*1.98*	473	365	*1.30*	*2.16*	0.88
1,495	886	*1.69*	356	295	*1.21*	*1.75*	0.99
2,651	1,150	*2.31*	608	267	*2.28*	*1.56*	0.56
2,737	1,174	*2.33*	528	218	*2.42*	*2.20*	0.79
2,592	1,480	*1.75*	548	240	*2.28*	*1.97*	0.80
2,636	1,057	*2.49*	537	264	*2.03*	*1.38*	0.43
2,551	971	*2.63*	564	203	*2.78*	0.87	0.33
2,653	1,174	*2.26*	592	255	*2.32*	0.87	0.57
1,486	1,235	*1.20*	507	348	*1.46*	*4.70*	*1.12*
1,835	1,069	*1.72*	510	243	*2.10*	*3.05*	0.40

(i) When l_g is the labor coefficient, M_j the export coefficient, A the technology coefficient:

$$l=\begin{bmatrix} l_i & & 0 \\ & l_j & \\ 0 & & l_n \end{bmatrix}, \quad \hat{M}=\begin{bmatrix} M_i & & 0 \\ & M_j & \\ 0 & & M_n \end{bmatrix}.$$

Then, West Germany: $l[I-(I-M)A]$; Japan: $l[I-A^d]$. (A^d is the input coefficient matrix related to domestically produced goods.)

(ii) Calculations used for Japan are from Ministry of Labor Secretariat, Statistical Information Department, *Rōdōryoku kankei jōhō* [Labor force statistics].

(iii) The input-output tables used were the 1970 tables for both Japan and West Germany. The relation between the two was established at the thirty-four sector level.

(iv) Exchange rate, 1DM=¥98.82.

nomic growth in West Germany was competitive in the relatively labor-using industrial machinery sector. In Japan, basic intermediate goods (iron and steel and chemicals, etc.) sector, which do not have the capacity to absorb labor, and large-scale assembly production industries (household electrical appliance and automobile) are in a comparatively high position. Moreover, the pursuit of scale merit in these sectors increasingly reduces the value of employment coefficient per unit. Confirmation for this may be found through the following input-output approach.

Table VII was compiled from an analysis of input-output tables of the two countries,[9] which indicates how a 10 billion yen increase in production or exports

[9] The data sets used in the study are the Japanese Input-Output Table, 1970 [10] and the West German Input-Output Table, 1970, published by the government ("Input-Output-Tabelle, 1970," *Wirtschaft und Statistik*, 3/1974 [Statistische Bundesamt, West Germany]). Both tables were aggregated to thirty-four sectors for the comparative analysis based on the mutually compatible input-output tables.

in an industry contributes to direct employment in its own sector and to indirect employment in other sectors. Assuming a 10 billion yen increase in exports for chemical industries in the Japanese industrial structure, the direct and indirect ripple effect will cause an increase in employment for 1,004 persons in the chemical sector and for 2,168 persons in other sectors, a nationwide increase of 3,172. In the West German industrial structure, this will create an increase in employment of 1,247 in its own sector and 1,095 in other sectors, a total of 2,342 people.

The table also shows that:

(a) In all sectors of column A, except iron and steel and primary steel products, the employment volume in the entire economy induced in Japan is larger than that in West Germany. This means that the induced quantity of employment per unit is larger in all Japanese industries than in all West German industries.

(b) In contrast, if only iron and steel and primary steel products sectors are taken into consideration, the induced quantity of employment is smaller per unit than in other Japanese industries and even smaller than those in West Germany.

(c) Columns B and C reveal more interesting facts. The labor force required in its own sector of column B is smaller in Japan as opposed to column A except for metal products. This indicates that in each sector, the productivity of each worker is generally higher in Japan and this is especially true in iron and steel. In contrast, as column C shows, in the production of each industry, the amount of indirect labor required is overwhelmingly larger in Japan.

(d) The induced indirect labor is especially large in Japan. This can be confirmed in column E giving the multiplier ratio of direct and indirect employment. In Japan, this ratio is often larger than 1. This indicates that the quantity of employment induced in other sectors is larger than the amount of direct labor required for its own sector. In the case of West Germany, this multiplier ratio is always smaller than 1. From this aspect, it is no exaggeration to say that Japan's employment structure is supported by excessively expanded indirect sectors.

(e) Columns 10, 11, and 12 give a breakdown of induced employment in the indirect sectors. In Japan, this is twice as large as West Germany in the commercial sector, including wholesale and retail, and in the transport sector.

By integrating the above observations, we find that Japan's distribution process in basic industries such as iron and steel, nonferrous metals, chemicals, and machineries involves a succession of first, second, and at times third and fourth-stage wholesalers before reaching the retailer. While labor productivity in these basic industries is relatively high, as shown in the direct sector column of the table, a large proportion of the employed population is absorbed by indirect sectors accompanying these production activities, especially in the distribution sector. This is a noted characteristic of Japan's employment structure.

For instance, iron and steel has low absorption capacity of its own (Table VII, column 1). Even if the labor absorption capacity of indirect sectors is taken into account, the absorption capacity per production unit is small compared to other industries. Nevertheless, the base is extremely wide for related sectors influenced by economic conditions of iron and steel industry. This is because a scale of iron and steel production, with no equal excepting the United States and the USSR, an annual capacity of 120 million tons, and a high growth rate have supported those employed in the widespread indirect sectors.

This example shows that the base of the Japanese employment structure spreads extensively into the indirect sectors, especially into the distribution sector of basic industries. This demonstrates the retarded character of the structure compared to West Germany.

This peculiarity in employment structure is considered to be derived from the past industrial policies favoring chemical and heavy industry. As it has been repeatedly pointed out in other instances, the Japanese economic growth has used the leverage provided by the heavy industry sector with its low labor absorption capability. Under such a structural development, a huge labor force had to be absorbed by the related sectors surrounding the basic industries. This has typically resulted in the appearance of an excessively expanded distribution sector.

Looked at in this way, the structural differences between the two countries become clear. The basic framework for Japan's development based upon heavy industries creates a situation where the more the production and export of the leading sectors grow, the smaller the employment coefficient per unit. On the contrary, in West Germany, the development of the machinery sector creates a trend for increased absorption of manpower. In other words, in West Germany, relations between the production, export, and employment are such that relative changes in them develop simultaneously and in parallel. But in Japan's case, the relations between production and exports on the one hand, and employment on the other, show a tendency towards more uneven progress.

In the case of Japanese economy, a vast amount of capital was concentrated in the large-scale technology sector which has a low potential for absorbing labor. However, in order to support the employment of 50 million workers, a quantitative adjustment became necessary leading to rapid expansion in this sector. As a result, the heavy industry sector was oriented in the 1960s towards geometrical expansion and large-scale domestic development projects were launched to maintain demand for their products. The resulting comparative advantage stimulated a trend towards an export of heavy industrial products. Such a mechanism made possible the maintenance of a high growth economy in the long periods.

CONCLUSION

Conclusions of this study are summarized as follows: In the 1950s and 1960s:

(1) The peculiarities of the Japanese industrial structure can be found in an excessive expansion in the basic intermediate goods sector.

(2) The steady expansion of demand in the basic intermediate goods sector was launched by the government's industrial planning that took place in a concentrated form by the latter half of the 1950s and onto the end of the 1960s.

(3) The technology of this basic intermediate goods sector is that of the K(I-B)

type. The pursuit of economies of scale from both labor and capital inputs so long as demand continued to expand brought about an increase in productivity through increased capacity and augmented the comparative advantage of this sector. As a result, the K(I-B) share in exports increased rapidly.

(4) The more the production and exports of the K(I-B) type sector increase, technologically, the employment coefficient per unit of these sectors diminishes. As a result, from the production aspect, the basic intermediate goods sector, which took a leading role in the growth, excessively expanded. In employment, since these leading sectors did not have the ability to absorb direct manpower, labor was absorbed by the indirect sectors. This caused an uneven progress in production and employment structures, and the tendency has resulted in the present structure of Japanese economy which largely relies on the growth of heavy industry.[10]

[10] In the 1970s this development pattern has begun to make a major change. The rate of production increase in the K(I-B) type sector has slowed down, while production and exports of machinery, K(I-M) type, are increasing. However, it seems true that the heavy industry type industrial structure nurtured since the end of the war will not easily change on short notice. Japanese economists contend that the Japanese economy, which in the past maintained a high annual growth rate in the neighborhood of 10 per cent, will and should be on a steady growth rate of 5 to 6 per cent per annum. This study emphasizes that the growth issue should not be debated from a macro viewpoint, but that it requires change in production and employment structures.

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