

FACTOR ABUNDANCE IN EAST AND SOUTHEAST ASIAN COUNTRIES: AN EMPIRICAL STUDY WITH LEONTIEF'S AND LEAMER'S FORMULAS

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INTRODUCTION

EAST and Southeast Asian countries achieved rapid economic development and industrialization during the 1970s, and the transformation of the structure of their trade and industry has also been remarkable. The industrialization and trade strategies of these countries are frequently argued on the basis of the comparative advantage theory or the Heckscher-Ohlin theorem which says under some assumptions: "a country exports (imports) the goods which is relatively more intensive in the factor which is relatively more (less) abundant in that country." For example, it is often argued that because East and Southeast Asian countries are generally abundant in cheap labor, they have a comparative advantage in labor-intensive goods. However, whether these countries are comparatively abundant in cheap labor or not is an empirical subject but not necessarily a definite fact, for at present empirical research on factor abundance in East and Southeast Asia has been limited to Japan and the Republic of Korea about which a number of reports have been produced. In order to consider the factors involved in the rapid industrialization of these countries, it is important to confirm empirically the condition of factor abundance in their trade structures during this period of rapid growth.

On theoretical aspects concerning factor abundance, various efforts to preserve and develop the Heckscher-Ohlin theorem have been made since the paradoxical conclusion of Leontief in 1953 of the U.S. trade structure. For example, the problem of labor quality, R & D investment, factor intensity reversal, or the cases of three or more production factors can be raised. In addition to these efforts, Leamer proposed a new index in 1980, saying that "Leontief's figures, which produced the so-called paradoxical result that U.S. exports are less capital intensive than U.S. competing imports, can also be used to show that U.S. net exports are more capital intensive than U.S. consumption, which in fact implies that capital is abundant relative to labor. There is no paradox if the conceptually correct calculations are made."

In this paper we will apply the indexes of Leontief and Leamer both and measure factors embodied in imports and exports of four countries (Korea, Taiwan, Malaysia, and Japan) during the 1970s. Then using the resulting measurements, we will make a comparison of factor abundance and the trade structure of the four countries.

In Section I, we will set forth Leamer's argument and its meaning. In Section II, capital and labor embodied in the imports and exports of these countries will be estimated in order to see factor abundance. Then, in Section III, we will increase the numbers of factors by taking into consideration labor quality or natural resources. In Appendix our method of measurement and the data used are explained.

I. THE LEONTIEF AND LEAMER INDEXES

Since first set forth, it has been pointed out that the Leontief index, which covered many goods and two factors (capital-labor ratio embodied in exports K_e/L_e and capital-labor ratio embodied in imports K_m/L_m), has only a limited validity.¹ Unlike the two-good two-factor Heckscher-Ohlin model where the labor-capital ratio has been used to good effect, when we cover many goods and many factors, it becomes difficult to use the capital-labor ratio. Leamer [3], paying attention to this point, uses the Heckscher-Ohlin-Vaneck model which extends the two-good two-factor model to the M -good N -factor model. As a result, a more general index is not a ratio concept but a net export concept. In other words, the net export of each factor embodied in imports and exports can be shown in the two factors:

$$(K_e - K_m), (L_e - L_m).$$

If we consider two goods and two factors as a special case, then the Leontief index, K_e/L_e , K_m/L_m can be derived [3, p. 50, Corollary 5]. Using this general index, Leamer proves that the necessary and sufficient condition for a country to be more abundant in capital than labor must satisfy one of the following three conditions [3, p. 496]:

$$(a) \quad K_e - K_m > 0, \quad L_e - L_m < 0,$$

$$(b) \quad K_e - K_m > 0, \quad L_e - L_m > 0,$$

$$\frac{K_e - K_m}{L_e - L_m} > \frac{K_c}{L_c},$$

$$(c) \quad K_e - K_m < 0, \quad L_e - L_m < 0,$$

$$\frac{K_e - K_m}{L_e - L_m} < \frac{K_c}{L_c},$$

where K_c and L_c are capital and labor embodied in domestic production (domestic demand) respectively.

¹ See, for example, [6] [7].

Condition (a) is easy to understand even intuitively. If a country's capital embodied in net exports is positive and labor is negative, the country exports capital service to the world in net and imports labor service from the world. Accordingly it would be pointed out that the country is relatively abundant in capital compared with the world. Conditions (b) and (c) are not so easily understood as they involve the exporting of both capital service and labor service to the world (importing both from the world). In both cases, the problem is whether exports (imports) of capital service per one unit of labor service exports (imports) are larger (smaller) than capital service per one labor unit served to domestic expenditure, "capital intensity." The fact that "capital intensity" served to exports is larger than "capital intensity" in domestic expenditure means that the country has a comparative advantage in capital vis-à-vis the world, and shows that the country is relatively more abundant in capital. At the same time, the fact that "capital intensity" of imports of the country (that world exports to the country) are smaller than that of domestic expenditure of the country shows that the world has a comparative advantage in labor against this same country; and thus the country has a comparative advantage in capital.

Leamer concludes that since all three inequalities of condition (b) are in accord with Leontief's figure of 1947, the United States is a capital service exporting country, and Leontief's paradox does not exist. Moreover, Leamer also shows that if the number of goods is more than two, then a country can be called either capital-abundant or labor-abundant when judged by the index which Leontief used [3, p. 499, Corollary 4]; thereby pointing out an insufficiency in the Leontief index.

Supporting Leontief, however, Brecher-Choudhri in 1982 pointed out the fact that the United States had in that period a net export of labor which was itself paradoxical [1]. In fact, it can be easily shown that the net export of labor is positive only when domestic expenditure per capita of one country is lower than that of the world. It would be wrong to think that the United States in that period was an example of this case.

Leamer accepted this comment in his book published in 1984, and suggested that the problem is probably the quality of labor, and we can overcome this problem by distinguishing between (the export of) skilled labor and (import of) unskilled labor [4]. Since Leamer's contribution exists in proposing new index for factor abundance theory in case of M goods and N factors, increasing the number of factors like this can be considered a natural extension.

Based on the details presented above, we will try to calculate both the Leontief and Leamer indexes using data on East and Southeast Asian countries. First we will try to apply the two indexes using multiple goods and two factors, and compare the two indexes. Then we will make our calculations taking labor quality and natural resources into account.

II. FACTOR ABUNDANCE: TWO FACTORS CONSIDERED

This section discusses the results of measurement for two production factors (capital and labor) for the four countries being studied.

TABLE I
LEONTIEF INDEX: CAPITAL AND LABOR

		1965	1970	1975
Japan	Leontief index	1.227	1.188	1.177
	K_e/L_e	2.16	3.35	5.78
	K_m/L_m	1.76	2.82	4.91
Korea	Leontief index		1.122	0.847
	K_e/L_e		1.36	1.88
	K_m/L_m		1.21	2.22
Taiwan*	Leontief index		0.753	0.905
	K_e/L_e		67.9	334.0
	K_m/L_m		90.2	369.0
Malaysia	Leontief index		0.786	0.946
	K_e/L_e		4.46	6.28
	K_m/L_m		5.67	6.64

Sources: See Appendix.

* Figures for 1971 and 1976 respectively.

A. Leontief Index

Table I shows the results using the Leontief index. For Japan, the results of 1965, 1970, and 1975 are reported, while for the other three countries, only 1970 and 1975 are given. In the table, the capital-labor ratio of exports, K_e/L_e , is the ratio of capital embodied in export per unit K_e and labor embodied in export per unit L_e . The capital-labor ratio of imports K_m/L_m is the ratio of capital K_m and labor L_m needed per unit to produce imports domestically. In addition, the Leontief index is defined as the ratio of the capital-labor ratio of exports divided by the capital-labor ratio of imports, $(K_e/L_e)/(K_m/L_m)$.

For Japan, the figures of the Leontief index are all greater than 1, and the country's trade structure is that of capital-abundant country. This corresponds to the results of other studies. For example, according to Tatemoto et al., the ratio of the Leontief index in 1965 was 1.536.²

For Korea, the Leontief index is 1.122 for 1970, meaning capital abundant, but it changes to 0.847 for 1975, meaning labor abundant.³

Taiwan's index is 0.753 for 1970 and 0.905 for 1975 (both less than 1), indicating that its trade structure has the pattern of a labor-abundant country. Malaysia's index is 0.786 for 1970, and 0.946 for 1975, thus also showing the pattern of a labor-abundant country.

B. Leamer Index

The results of the Leamer index are shown in Tables II-V. In each table the first row (1) represents net export of capital which is the balance between the

² Here we only point out that our results are the same as [7]. However it is difficult to compare the figures, since industrial classifications and input-output tables are different.

³ For decomposition of factor intensity in Korea, see [5].

TABLE II
LEAMER INDEX: CAPITAL AND LABOR (JAPAN)

	1965	1970	1975
(1) Net export of capital	-2.9	-6.4	-2.6
(2) Net export of labor	-2.7	-3.3	-1.7
(3) Ratio [(1)/(2)]	1.06	1.95	1.52
(4) Domestic use of capital	59.1	103.0	164.1
(5) Domestic use of labor	45.6	49.1	49.6
(6) Domestic ratio [(4)/(5)]	1.29	2.11	3.32
Factor abundance			
Leamer index	Capital	Capital	Capital
Sign [(1), (2)]	[-,-]	[-,-]	[-,-]
Leamer's ratio [(3):(6)]	(3)<(6)	(3)<(6)	(3)<(6)
Case	(c)	(c)	(c)
Leontief index	Capital	Capital	Capital

Sources: See Appendix.

capital embodied in exports (which is itself equal to capital and export K_e) and the capital embodied in imports (which is itself equal to capital import K_m); or $K_e - K_m$. The second row (2) represents net export of labor and is the same balance as in (1) with respect to labor; or $L_e - L_m$. The fourth row (4) is domestic consumption of capital embodied in the production of domestic consumption K_e and the fifth row (5) is domestic consumption of labor embodied in the production of domestic consumption L_e .

At this point one must remember Leamer's conditions for a capital-abundant country. They are (a) net exporter of capital [(1) > 0] and net importer of labor [(2) < 0], (b) net exporter of both capital and labor [(1) > 0, (2) > 0] but the export ratio is larger than the capital-labor ratio embodied in its domestic consumption [(3) > (6)], and (c) net importer of both capital and labor [(1) < 0, (2) < 0] but its net export ratio is smaller than its capital-labor ratio of domestic consumption [(3) < (6)]. If the converse of one of the three cases of above results [(a'), (b'), and (c') respectively], the country is judged to be a labor-abundant country.

The results for Japan are shown in Table II. The figures for 1965 show (1) < 0 and (2) < 0 which means that the country is a net importer of both capital and labor and represents a case of (c). The net export ratio (3) is 1.06 and the capital-labor ratio (the production embodied in domestic consumption) (6) is 1.29; thus (3) is less than (6), and the trade structure of Japan for that year is one of a capital-abundant country. This is the same as the result of the Leontief index above. The years of 1970 and 1975 also fall under (c) where (3) < (6), thereby indicating a capital-abundant country, again the same result as the Leontief index above.

The results for Korea, shown in Table III, are likewise the same for both indexes.⁴ For both 1970 and 1975, the country is a net importer of capital and

⁴ Hwang did a similar study for Korea [2].

TABLE III
LEAMER INDEX: CAPITAL AND LABOR (KOREA)

	1970	1975
(1) Net export of capital	-0.40	-0.70
(2) Net export of labor	-0.43	-0.02
(3) Ratio [(1)/(2)]	0.92	29.27
(4) Domestic use of capital	9.66	17.91
(5) Domestic use of labor	9.65	10.62
(6) Domestic ratio [(4)/(5)]	1.00	1.69
Factor abundance		
Leamer index	Capital	Labor
Sign [(1), (2)]	[-, -]	[-, -]
Leamer's ratio [(3):(6)]	(3) < (6)	(3) < (6)
Case	(c)	(c)
Leontief index	Capital	Labor

Sources: See Appendix.

TABLE IV
LEAMER INDEX: CAPITAL AND LABOR (TAIWAN)

	1970	1975
(1) Net export of capital	-31.0	54.5
(2) Net export of labor	0.018	0.38
(3) Ratio [(1)/(2)]	-	142.0
(4) Domestic use of capital	265.0	1,158.0
(5) Domestic use of labor	4.16	4.34
(6) Domestic ratio [(4)/(5)]	63.7	267.0
Factor abundance		
Leamer index	Labor	Labor
Sign [(1), (2)]	[-, +]	[+, +]
Leamer's ratio [(3):(6)]	-	(3) < (6)
Case	(a')	(b')
Leontief index	Labor	Labor

Sources: See Appendix.

labor. The trade structure for 1970 reveals that of a capital-abundant country because the capital-labor ratio of net imports is 0.92 and the capital-labor ratio of domestic production is 1.001, thus indicating that the ratio of capital and labor used for domestic consumption is higher than the ratio of imported capital and labor [(3) < (6)]. For 1975, (3) is larger than (6) [(3) > (6)] which means labor-abundant.

The results for Taiwan, shown in Table IV, are different from those for Japan and Korea. The figures for 1970 show that capital is net imported [(1) = -31.0] and that labor is net exported [(2) = 0.018], which means Taiwan is a labor-abundant country. It imports capital and exports labor, which is the converse of

TABLE V
LEONTIEF INDEX: CAPITAL AND LABOR (MALAYSIA)

	1970	1975
(1) Net export of capital	1.0	0.27
(2) Net export of labor	4.1	0.10
(3) Ratio [(1)/(2)]	2.53	2.59
(4) Domestic use of capital	10.0	18.9
(5) Domestic use of labor	1.74	2.41
(6) Domestic ratio [(4)/(5)]	5.74	7.85
Factor abundance		
Leamer index	Labor	Labor
Sign [(1), (2)]	[+, +]	[+, +]
Leamer's ratio [(3):(6)]	(3) < (6)	(3) < (6)
Case	(b')	(b')
Leontief index	Labor	Labor

Sources: See Appendix.

Leamer's case (a) [(a')]. For 1975, it is the converse of case (b) [(b')]. Both capital and labor are exported (54.5, 0.38), but the ratio of capital and labor used for domestic consumption is higher than the ratio of exported capital and labor [(3) < (6)], which means a labor-abundant country. This again is the same as the results of the Leontief index.

In Malaysia's case, shown in Table V, capital and labor are exported in both 1970 and 1975 which means (3) < (6); thus this is a case of (b') and the country's trade structure is that of a labor-abundant country, the same as that shown in the Leontief index.

III. FACTOR ABUNDANCE: THREE FACTORS CONSIDERED

In this section, we will separate labor into two kinds, skilled and unskilled, and estimate the abundance of three production factors for the three countries of Japan, Korea, and Taiwan. Factor abundance for Malaysia will be analyzed using natural resources.

A. *Skilled and Unskilled Labor*

Labor is separated into skilled labor L_s and unskilled labor L_u using employment matrix data for each country.⁵ For both the Leontief and Leamer indexes, factor abundance for each country is ranked by the three production factors comprising capital and skilled labor, capital and unskilled labor, and skilled labor and unskilled labor respectively.

The results are shown in Table VI. Detailed figures are given in Appendix Table II. According to the Leontief index, for both 1970 and 1975 Japan is

⁵ We define administrative and technical specialists as skilled labor, while others as unskilled labor.

TABLE VI
ORDER OF FACTOR ABUNDANCE FOR THREE FACTORS

		1970			1975		
Japan	Leontief index	L_s	K	L_u	L_s	K	L_u
	Leamer index	L_s	K	L_u	L_s	K	L_u
	Sign	-	-	-	-	-	-
Korea	Leontief index	L_s	K	L_u	L_s	K	L_u
	Leamer index	L_s	K	L_u	L_s	L_u	K
	Sign	-	-	-	-	-	-
Taiwan	Leontief index	L_s	L_u	K	L_u	L_s	K
	Leamer index	L_u	L_s	K	L_u	L_s	K
	Sign	+	+	-	+	+	+

Sources: See Appendix.

endowed abundantly with skilled labor; this is followed by capital and then unskilled labor. Using the Leamer index, though all three factors are net imported, the ratio to domestic consumption shows that the ranking of abundance is in the order: skilled labor, capital, unskilled labor, as the Leontief index. The results for Korea are the same as those for Japan in 1970 and 1975 when using the Leontief index, but they are different when using the Leamer index. The ranking for 1975 is skilled labor, unskilled labor, and capital.

Looking at Taiwan, the Leontief index shows a ranking for 1970 of skilled labor, unskilled labor, and capital. The results of Leamer index, however, show that capital is net imported and that skilled and unskilled labor are net exported. Considering the ratio to domestic consumption, the results are different from those of Leontief, whose ranking is unskilled labor, skilled labor, and capital. For 1975 the Leamer index shows that all three production factors are net imported, but considering the ratio of domestic consumption, the order of ranking is unskilled labor, skilled labor, and capital, which is the same as with the Leontief index.

The notable point about factor abundance shown by the results above is that Korea is very similar to Japan and contrasts markedly with Taiwan whose ranking of unskilled labor, skilled labor, and capital is the pattern shown by developing countries. This difference may be due to the difference in direction taken by industrialization in Korea and Taiwan or perhaps to a difference in their industrial structure.

B. *Natural Resources*

There have been few efforts made to estimate the natural resource endowment of each country. Here we will try to make an estimation for Malaysia, applying the method of Tatemoto et al. [7]. These researchers used the amount of products made from natural resources as approximate variables because natural resources cannot be measured directly. They calculated the amount of intermediate products demanded for domestic agriculture, forestry, fishery, and mining when one unit of the final demand in each industry is increased. This corresponds to the sums of

TABLE VII
NATURAL RESOURCES EMBODIED IN EXPORTS AND IMPORTS
(Per U.S.\$1 of each final demand)

	Replenishable Resources	Depletable Resources			Total*
		Petroleum/ Natural Gas	Metal Mineral	Nonmetal Mineral	
Indonesia					
Export	0.582	1.263	0.659	0.004	2.508
Import	0.584	0.626	0.119	0.047	1.376
West Malaysia					
Export	0.981	0.000	0.374	0.223	1.577
Import	0.553	0.000	0.206	0.114	0.872
Philippines					
Export	0.389	0.034	0.821	0.079	1.283
Import	0.233	0.008	0.117	0.045	0.403
Singapore					
Export	0.316	0.000	0.000	0.312	0.628
Import	0.371	0.000	0.000	0.152	0.523
Thailand					
Export	0.380	0.000	0.261	0.146	0.788
Import	0.246	0.000	0.162	0.113	0.522
Japan					
Export	0.071	0.001	0.016	0.038	0.126
Import	0.242	0.032	0.025	0.085	0.384
Korea					
Export	0.131	0.000	0.380	0.171	0.682
Import	0.223	0.000	0.044	0.199	0.466
U.S.A.					
Export	0.309	0.090	0.103	0.186	0.689
Import	0.415	0.239	0.101	0.228	0.983

Source: Calculated from Institute of Developing Economies, *International Input-Output Table for ASEAN Countries, 1975*, IDE Statistical Data Series No. 39 (Tokyo: Institute of Developing Economies, 1982).

* The sum of each column, per U.S.\$4 of each final demand.

each column for agriculture, forestry, fishery, and mining in the inverse matrix of the input-output table. Tatemoto et al. divided this total into depletable natural resources (mainly mining) and replenishable resources, and calculated Japan's resources for 1965. Yokoyama and Itoga [8] can be cited as an example using the same method. In this work, they calculated the vector of the amount of natural resources for twenty-six industries in ten countries, including ASEAN, in 1975. They took the inner product of this vector using export-import vectors, and regarded these figures as the amount of domestic natural resources embodied in imports and exports. Table VII shows their results.

In this study we calculated the amount of natural resources embodied in imports and exports using the same method. Together with the two factors of capital and

TABLE VIII
ORDER OF FACTOR ABUNDANCE (MALAYSIA)

	1970			1975		
Leontief index	R	L	K	R	L	K
Leamer index	R	L	K	R	L	K

Sources: See Appendix.

labor estimated in the previous section, we compared the factor abundance of three production factors using the Leontief and Leamer indexes. Table VIII shows the results we obtained. As can be seen from this table, the estimates of both indexes show Malaysia to be abundant in natural resources, labor, and capital for both 1970 and 1975.

CONCLUSION

In this paper, we examined the factor abundance for four countries in East and Southeast Asia using the Leontief and Leamer indexes. Our main findings can be summarized as follows. First, when we consider the two factors of capital and labor using the two indexes, both Japan and Korea in 1970 were estimated to be capital abundant, while Korea, Taiwan, and Malaysia are labor abundant. Japan and Korea were found to be both net importers of capital and labor while both Malaysia and Taiwan in 1975 were net exporters of both factors. Taiwan in 1970 net imported capital and net exported labor.

Second, when we consider the three factors of capital, and skilled and unskilled labor, the ranking of abundance for Japan and Korea is skilled labor, capital, and unskilled labor while for Taiwan it is unskilled labor, skilled labor, and capital. Though Korea and Taiwan are both regarded as Asian NIEs, the difference in the results for the two countries apparently shows the differences in their trade and industrial structures.

Third, when looking at the three factors of capital, labor, and natural resources, it was shown that the ranking of factor abundance for Malaysia is resources, labor, and capital. This can be considered the typical pattern for trade and industrial structure of any resource abundant country.

Fourth, though the results derived from both the Leontief and Leamer indexes were found to be almost the same, there are some countries which net export both labor and capital [case (b)] and some others which net import both labor and capital [case (c)], as Leamer indicated; this denies the argument that capital abundant countries always net export capital and net import labor [case (a)]. In this sense, the Leamer index gives a better estimate of factor abundance.

In order to be sure that these results correctly reflect the factor abundance of each country, other arguments are needed than just the Leontief and Leamer indexes which are based on the Heckscher-Ohlin theorem. For instance, the effects of industrialization and trade policy in each country or the movement of international capital, both of which have been so far ignored in the world of the Heckscher-Ohlin theorem, should be examined in detail.

Before ending this paper, we would like to conclude with some topics which can be examined in the future concerning the estimation of factor abundance. First, for the study of developing countries, it is necessary to organize the series of reliable data classified by industry, especially as industry-wise capital stock is not available in most countries. Secondly, when we further conduct international comparisons, common classification of industries will be needed as well as conversion to the common term in each country as base year and currency unit. Thirdly, concerning the input-output tables used for calculation, we used competitive import-tables in this paper following the methods of Leontief and Leamer, but it is also necessary for the indexes to take into consideration the import structures for intermediate goods. Lastly, to investigate determining factors of trade patterns for each country one has to analyze not only capital and labor but also many other production factors including the quality of labor, know-how, and natural resources.

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APPENDIX

1. *Method of Measurement*

As Leontief did, we estimate capital and labor embodied in exports and imports, using the inverse matrix of each input-output table. Letting x , A , eE , mM , and cF^d represent respectively gross output, input-output coefficient matrix, exports, imports, and domestic expenditures, then:

$$x = Ax + cF^d + eE - mM,$$

therefore,

$$x = (I - A)^{-1}(cF^d + eE - mM).$$

Here I is a unit matrix and e , m , and c are share vectors of exports, imports, and domestic expenditures.

By multiplying the capital coefficient vector, k , from the left-hand side,

$$k'x = k'(I - A)^{-1}(cF^d + eE - mM),$$

then the capital embodied in total exports E and imports M is respectively:

$$\begin{aligned} K_e &= k'(I - A)^{-1}eE, \\ K_m &= k'(I - A)^{-1}mM. \end{aligned}$$

If we further let K_c represent the capital embodied in total domestic expenditures F^d , then

$$K_c = k'(I - A)^{-1}cF^d.$$

Similarly if we define the labor coefficient vector as l , then

$$\begin{aligned} L_e &= l'(I - A)^{-1}eE, \\ L_m &= l'(I - A)^{-1}mM, \\ L_c &= l'(I - A)^{-1}cF^d. \end{aligned}$$

2. Data

The main sources of data used for each country are shown below. Detailed information can be obtained from the authors upon requests.

Korea:

- (1) Bank of Korea, *1970 Input-Output Tables* (Seoul, 1975).
- (2) ———, *1975 Input-Output Tables (II)* (Seoul, 1978).
- (3) ———, *National Income in Korea, 1982* (Seoul, 1982).
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- (5) Economic Planning Board, *1970 Population and Housing Census Report*, Vol. 2, *10% Sample Survey*, No. 4-1, *Economic Activity* (Seoul, 1973).
- (6) ———, *1974 Special Labor Force Survey Report* (Seoul, 1976).
- (7) ———, *1975 Population and Housing Census Report*, Vol. 2, *5% Sample Survey*, No. 3-1, *Economic Activity* (Seoul, 1978).

Malaysia:

- (1) Department of Statistics, *Input-Output Tables: Peninsular Malaysia, 1970* (Kuala Lumpur).
- (2) ———, *Survey of Manufacturing Industries, West Malaysia, 1970* (Kuala Lumpur).
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3. *Industrial Classifications*

Industrial classifications are summarized in Appendix Table I for each country.

4. *Results for Three Factors*

Following Appendix Table II is the detailed results of the studies for three factors for Korea, Taiwan, and Japan.

APPENDIX TABLE I
INDUSTRIAL CLASSIFICATION

A. Korea	
1. Agriculture, forestry, and fisheries	11. Electrical equipment
2. Mining	12. Transportation equipment
3. Construction	13. Other manufactures
4. Food	14. Commerce
5. Textiles	15. Finance and insurance
6. Paper and pulp	16. Real estate
7. Chemicals	17. Transport and communications
8. Basic metals	18. Utilities (power, gas, water)
9. Metal products	19. Other services
10. General machinery	

B. Malaysia

Industries (20)	1970		1975	
	I-O (60)	Survey (95)	I-O (105)	Survey (113)
1. Food preserved	8-14	3-22	17-33	1-24
2. Beverage	15	23-25	34	25-27
3. Tobacco	16	26	35	28
4. Fabrics	17	27	36-38	29-38
5. Apparel & leather products	18	28-30, 44, 45	39-42	39-42
6. Timber	19	31-36	43	43-48
7. Wood furniture	20	37-38	44-46	49
8. Paper, pulp & printing	21	40-43	47-50	50-53
9. Rubber products	26, 27	1, 2, 46	59-61	64-68
10. Chemicals	22-24, 28	47-57	51-57, 62	54-61, 69
11. Petroleum refinery products	25	58	58	62, 63
12. Nonmetallic products	29-31	59-65	63-67	70-77
13. Metals	32	66-68	68-70	78-81
14. Metal products	33	39, 69-75	71, 72	82-88
15. Machinery	34	76-79	73-77	89-94
16. Electric machinery	35	80-83	78, 79	95-101
17. Transport equipment	36, 37	84-89	80-85	102-7
18. Other manufacturing	38	90-95	86-88	108-13
19. Agriculture, forestry, fishery & mining	1-7	—	1-16	—
20. Tertiary	39-60	—	89-105	—

Notes: 1. Figures in parentheses indicate the total numbers of sectors.

2. Numbers in the table represent corresponding numbers for sectors in each I-O Table and Survey.

C. Taiwan

Industries (66)	1971 (76)	1976 (99)
1. Agriculture & livestock	1-7	1-7
2. Forestry	8	8
3. Fishery	9	9
4. Coal	10, 3541, 3542, 3549	11
5. Metallic minerals	11	12
6. Crude petroleum & natural gas	12	13
7. Salt	13	14
8. Nonmetallic minerals	14	15
9. Slaughtering	18, 3110	16
10. Rice	15, 3117	17

C. Taiwan (Continued)

Industries (66)	1971 (76)	1976 (99)
11. Wheat	21, 3116	18
12. Sugar	16, 3118	19
13. Canning	17, 3113, 3114	20
14. Vegetable oil	22, 3115	21
15. Seasoning	20, 3121	22
16. Other food products	24, 25, 3111, 3112, 3120, 3122, 3126-29	23-25
17. Nonalcoholic beverages	23, 3133	26
18. Tobacco & alcoholic beverages	19, 3131, 3140	27, 28
19. Cotton & cotton fabrics	28, 3211	29
20. Wool & woolen fabrics	29, 3212	30
21. Synthetic fiber fabrics	27, 3214	31
22. Other fabrics & apparel	30, 3213, 3228-30, 3238, 3239	32-34
23. Leather & leather products	36, 3241, 3245, 3248, 3249	35
24. Timber	31, 3311	36
25. Plywood	32	37
26. Wood & other wood products	33, 3313, 3319, 3320	38, 39
27. Pulp, paper & paper products	34, 3411-15, 3419	40, 41
28. Printing & publishing	35, 3421-24	42
29. Rubber & rubber products	37, 3551-53, 3558, 3559	43
30. Industrial chemicals	43, 3511	44, 45
31. Chemical fertilizer	38, 3512	46
32. Synthetic fibers	26, 3515	47, 48
33. Plastics	40, 3513, 3560	49, 50
34. Medicine	39, 3522	51
35. Other chemical products	42, 44, 3514, 3521, 3523, 3524, 3529	52
36. Petroleum refinery products	41, 3530	53
37. Cement	45, 3692	54
38. Cement products	46, 3693	55
39. Glass	47, 3620	56
40. Other nonmetallic mineral products	48, 3610, 3691, 3699	57
41. Iron & steel	49, 3711, 3712	58, 59
42. Iron & steel products	50, 3811, 3812, 3814, 3815	60
43. Aluminum	51, 3721	61
44. Aluminum products	52, 3818	62
45. Other metal products	53, 3722, 3723, 3816, 3819	63, 64
46. General machinery	54, 3820	65-68
47. Household electrical appliances	55, 3833	69

C. Taiwan (Continued)

Industries (66)	1971 (76)	1976 (99)
48. Electronic products	56, 3832	70
49. Other electric products	57, 3831, 3834-39	71
50. Ship	58, 3841	72
51. Motor vehicle	59, 3843, 3844, 3848	73
52. Other transport equipment	60, 3849	74
53. Other industrial products	39, 61, 3850	75, 76
54. Building & construction	62-64	77-80
55. Electric power supply	65	81
56. Gas supply	66	82
57. Water supply	67	83
58. Water transport	68	84
59. Road transport	69	85, 86
60. Air transport	70	87
61. Storage facility services	71	88
62. Communication	72	89
63. Wholesale & retail trade	73	90
64. Financial & insurance services	74	91
65. Other services	75	10, 92-98
66. Not elsewhere classified	76	99

Notes: Same as Appendix Table IB.

D. Japan

Industries (20)	Link Tables (61)
1. Agriculture, forestry & fishery	1-5
2. Mining	6-10
3. Construction	42, 43
4. Food products	11-15
5. Textile	17-19
6. Pulp & paper	23
7. Industrial chemicals	27-29
8. Metal materials	33-35
9. Metal products	36
10. General machinery	37
11. Electric machinery	38
12. Transport equipment	39
13. Other industrial products	16, 20-22, 24-26, 30-32, 40, 41, 59
14. Commerce	47
15. Financial & insurance services	48
16. Real estate	49, 50
17. Transport & communication	51, 52
18. Electric power, gas & water supply	44-46
19. Services	53, 54, 56-58
20. Not elsewhere classified	60, 61

Notes: Same as Appendix Table IB.

APPENDIX TABLE II
ORDER OF FACTOR ABUNDANCE: CAPITAL,
SKILLED LABOR, AND UNSKILLED LABOR

A. Korea

	1970			1975			
	Factor A Factor B	K L _s	K L _u	L _s L _u	K L _s	K L _u	L _s L _u
Leontief index							
(1) Factor content ratio of exports (A _e /B _e)	35.6	1.25	0.035	75.1	1.76	0.023	
(2) Factor content ratio of imports (A _m /B _m)	38.3	0.99	0.026	97.1	1.63	0.017	
(3) Leontief's ratio [(1)/(2)]	0.93 < 1	1.26 > 1	1.35 > 1	0.77 < 1	1.08	1.40	
(4) Relative factor abundance	L _s > K	K > L _u	L _s > L _u	L _s > K	K > L _u	L _s > L _u	
(5) Order of abundance	L _s > K > L _u			L _s > K > L _u			
Leamer index							
(1) Net export of factor A (A _e - A _m)	-912	-912	-21.6	-2,495	-2,495	-14.7	
(2) Net export of factor B (B _e - B _m)	-21.6	-1,158	-1,158	-14.7	-1,699	-1,699	
(3) Leamer's ratio [(1)/(2)]	42.2	0.79	0.019	169.3	1.47	0.0087	
(4) Domestic ratio (A _e /B _e)	23.1	0.93	0.040	39.6	1.42	0.036	
(5) Relative factor abundance	L _s > K	K > L _u	L _s > L _u	L _s > K	L _u > K	L _s > L _u	
(6) Order of abundance	L _s > K > L _u			L _s > L _u > K			

Notes: 1. Unit: L_s, L_u = 1,000 workers; K = million won in 1975 prices.
2. A > B means that the factor A is relatively more abundant in the country than the world average.

B. Taiwan

	1971			1976			
	Factor A Factor B	K L _s	K L _u	L _s L _u	K L _s	K L _u	L _s L _u
Leontief index							
(1) Factor content ratio of exports (A _e /B _e)	488.0	78.8	0.1612	1,790.0	410.0	0.229	
(2) Factor content ratio of imports (A _m /B _m)	650.0	105.0	0.1611	1,799.0	463.0	0.258	
(3) Leontief's ratio [(1)/(2)]	0.75 < 1	0.75 < 1	1.0 > 1	0.99 < 1	0.89 < 1	0.89 < 1	
(4) Relative factor abundance	L _s > K	L _u > K	L _s > L _u	L _s > K	L _u > K	L _u > L _s	
(5) Order of abundance	L _s > L _u > K			L _u > L _s > K			
Leamer index							
(1) Net export of factor A (A _e - A _m)	-30.5	-30.5	+ 2.60	+54.5	+54.5	+0.033	
(2) Net export of factor B (B _e - B _m)	+ 2.60	+15.0	+15.0	+ 0.033	+ 0.350	+0.350	

B. Taiwan (Continued)

Factor A Factor B	1971			1976		
	K L_s	K L_u	L_s L_u	K L_s	K L_u	L_s L_u
(3) Leamer's ratio [(1)/(2)]	—	—	0.174	1,673.0	156.0	0.09
(4) Domestic ratio (A_c/B_c)	—	—	0.176	1,377.0	3,313.0	0.24
(5) Relative factor abundance	$L_s > K$	$L_u > K$	$L_u > L_s$	$K > L_s$	$K > L_u$	$L_u > L_s$
(6) Order of abundance	$L_u > L_s > K$			$L_u > K > L_s$		

Notes: 1. Unit: L_s, L_u =million workers; K =billion NT dollar at 1975 prices.

2. $A > B$ means that the factor A is relatively more abundant in the country than the world average.

C. Japan

Factor A Factor B	1970			1975		
	K L_s	K L_u	L_s L_u	K L_s	K L_u	L_s L_u
Leontief index						
(1) Factor content ratio of exports (A_e/B_e)	0.430	0.036	0.085	0.621	0.064	0.103
(2) Factor content ratio of imports (A_m/B_m)	0.554	0.033	0.054	0.697	0.053	0.076
(3) Leontief's ratio [(1)/(2)]	$0.78 < 1$	$1.22 > 1$	$1.58 > 1$	$0.89 < 1$	$1.21 > 1$	$1.36 > 1$
(4) Relative factor abundance	$L_s > K$	$K > L_u$	$L_s > L_u$	$L_s > K$	$K > L_u$	$L_s > L_u$
(5) Order of abundance	$L_s > K > L_u$			$L_s > K > L_u$		
Leamer index						
(1) Net export factor A ($A_e - A_m$)	-6.40	-6.40	-2.07	-2.55	-2.55	+2.89
(2) Net export factor B ($B_e - B_m$)	-2.07	-327.0	-327.0	+2.89	-171.0	-171.0
(3) Leamer's ratio [(1)/(2)]	3.09	0.0196	0.0063	—	0.0149	—
(4) Domestic ratio (A_c/B_c)	0.194	0.0237	0.122	—	0.0379	—
(5) Relative factor abundance	$L_s > K$	$K > L_u$	$L_s > L_u$	$L_s > K$	$K > L_u$	$L_s > L_u$
(6) Order of abundance	$L_s > K > L_u$			$L_s > K > L_u$		

Notes: 1. Unit: L_s, L_u =million workers; K =10 trillion yen at 1975 prices.

2. $A > B$ means that the factor A is relatively more abundant in the country than the world average.