Industrial Structure of Cambodia and the Role of Agriculture and Fishery in its Development

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Abstract

This paper reveals the industrial structure of Cambodia, based on some results from input-output analysis, and discusses the role of the agriculture and fishery sectors for its pro-poor growth. As a preparation for the analysis, we estimated an input-output table of Cambodia. An input-output analysis shows the following results. In Cambodia's economy, the garment industry plays an important role, realizing 14% of GDP and 500% of self-sufficiency. However, it induces smaller domestic income than the former Thailand fiber industry. This means that, compared with Thailand, it is difficult for Cambodia to actualize high savings and to secure funds for domestic investment. The agriculture, fishery, and food industry sectors have a tendency to induce both wide and high distribution of domestic income. These sectors have high potential to realize pro-poor growth in Cambodia.

Discipline: Agricultural economics
Additional key words: input-output analysis, poverty reduction, pro-poor growth

Introduction

This paper reveals the industrial structure of Cambodia, based on some results from input-output analysis, and discusses the role of the agriculture and fishery sectors for its pro-poor growth.

Since 1990, the Cambodian economy has been growing rapidly. The economic development has been strongly induced by the growth of the fiber industry, especially the garment industry[7]. According to Yamagata[12], the garment industry has not only stimulated the economy but also directly contributed to poverty reduction by absorbing laborers from rural areas.

However, there is a risk that the Cambodian garment industry cannot keep its place as an engine for economic growth even in the near future[2]. "The multi-fiber arrangement (MFA)", trade rule which limits one exporting country's share in another country's fiber products imports to a certain level, was abolished in 2005. Foreign investors, who own 95% of garment factories[7], lost a major merit of additional investment in Cambodia. Hence, it will be difficult to keep its past rapid growth and absorb more laborers. Now, a new strategy for poverty reduction is needed.

Since the 1990s, development assistance agencies have tended to pay attention to not only the macro economy of a recipient country but also the economic situation of the poor[10,11], because macro-economic growth is not a sufficient condition for poverty reduction. Broad-based economic growth is required. They call preferable eco-

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nomic growth which really contributes to poverty reduction, "pro-poor growth".

Methods

The input-output analysis was developed by W. Leontief [5], which utilizes an input-output table. No Cambodian official input-output table has been produced so far. The Global Trade Analysis Project (GTAP) has been engaged in estimation of a Cambodian input-output table, but their version has not been completed. Therefore, we began with an estimation. Based on the estimated input-output table, we conducted skyline analysis and key sector analysis, which are part of input-output analysis.

1. Estimation of an input-output table for Cambodia

Table 1 is Cambodia's input-output table estimated in this study. The table is the matrix of industry by industry and based on purchasers' prices in accordance with evidential data for estimation.

The estimation method is as follows. First, we estimated and filled in "value added" cells by multiplying each sector's total "value added"[9] by each sector's income distribution ratio[8]. Second, "total input and output" which are equivalent to production value of each sector were estimated and filled in by dividing each sector's total "value added"[9] by "value added ratios". Note that we had to estimate production of each sector by ourselves because Cambodia's national account statistics does not include each sector's production. "Value added ratios" and "input coefficients" were derived from results of sample cost surveys[6,9], interviews, and past input-output tables of Thailand and Vietnam. Third, transactions among industries were estimated and filled in by multiplying each sector's production by "input coefficients". Fourth, final demand values were estimated and filled in, based on results of a household income and expenditure survey, government budget statistics, investment statistics, and international trade account[9]. Finally, entries of the estimated preliminary table were adjusted by Generalized-RAS[3], a balancing method for a matrix with negative values.

At present, we cannot obtain data on cost structures of some sectors mainly in the service industry, and we are forced to substitute recent cost data from neighboring countries. Because production processes of service sectors are probably affected more by contemporary technology than by regionality, the substitution is thought to be allowable for the first quantitative analysis for the economy. However, the presence of service sectors in the economy is likely to increase. Data on service sectors will improve accuracy of the table and enable more detailed analysis and discussion.

2. Skyline analysis

Skyline analysis draws a skyline chart like Fig. 1, which shows international trade patterns (on the vertical axis) and presence of each industry in an economy (on the horizontal axis). The drawing method is as follows. An input-output table can be expressed as follows:

$$X = A \cdot X + F + E - M \qquad \text{Eq. 1}$$

where X is a column vector of total output, A is "input coefficient matrix" which shows what kind and how many intermediate inputs are needed for one unit production, F is a column vector of domestic final demand, E is an export column vector, and M is an import column vector. Solving Eq. 1, X can be decomposed into three inducing factors as follows:

$$X = (I - A)^{-1} \cdot F + (I - A)^{-1} \cdot E - (I - A)^{-1} \cdot M \qquad \text{Eq. 2}$$

where the first term of the right-hand side indicates the production induced by domestic final demand F, the second term indicates the production induced by export E, and the last term indicates the potential domestic production to be substituted for import M. Based on Eq. 2, a skyline chart shows each factor's relative contributions to production on the vertical scale, with 100% representing $(I - A)^{-1} \cdot F$. In addition, the horizontal scale shows the sectoral share in total production.

3. Key sector analysis

This analysis shows properties of an economy by using some kinds of indicators. Our study used two kinds of indicators, an output multiplier and value added multiplier.

The output multiplier (IO multiplier) is an indicator which shows the power of final demand for each sector to stimulate economic activity. Usually, one unit of final demand induces more production than itself. The higher value of the indicator means the more induced production. Assuming that import is in proportion to domestic demand, Eq. 1 can be transformed as follows:

$$X = A \cdot X + F + E - \widetilde{M}(A \cdot X + F) \qquad \text{Eq. 3}$$

where $\widetilde{M}$ is a diagonal matrix of import coefficients. Solving Eq. 3 for X, we obtain the following equation:

$$X = \left\{ I - (I - \widetilde{M})\,A \right\}^{-1} \cdot \left\{ (I - \widetilde{M})\,F + E \right\} \qquad \text{Eq. 4}$$

where $\left\{ I - (I - \widetilde{M})\,A \right\}^{-1}$ is called "Leontief inverse matrix" and includes information on the industrial structure of an economy. The output multiplier is the sum of column vectors of this matrix.

The value added multiplier (ultimate value ra-

Table 1. Input-output table of Cambodia 2003

Cambodia IO Table 2003 v.7 — Billion riel 16 sectors, Purchaser's price	1 Paddy	2 Cereals, beans, and vegetables	3 Cash crops	4 Other crops	5 Livestock	6 Fishery	7 Forestry	8 Mining and quarrying	9 Food products and beverages	10 Textiles and apparel	11 Other manufactures and utilities	12 Construction	13 Trade	14 Hotels and restaurants	15 Transportation and communication	16 Other services	Total Intermediate Output
1 Paddy	294.00	14.13	0.01	4.00	0.00	0.00	0.00	0.00	655.80	0.00	0.38	0.00	0.00	213.73	0.00	0.08	1,182.12
2 Cereals, beans, and vegetables	0.00	115.27	0.00	0.00	0.00	0.00	0.00	0.00	61.06	0.00	0.00	0.00	0.00	48.52	0.00	5.87	230.74
3 Cash crops	0.00	0.00	26.00	0.37	0.00	0.00	0.00	0.00	30.88	100.51	116.17	0.00	0.01	1.18	0.00	0.11	275.22
4 Other crops	107.08	51.76	15.94	16.25	0.00	4.49	4.62	0.00	3.06	3.73	1.32	0.17	0.00	4.61	0.18	6.82	216.33
5 Livestock	0.00	0.00	0.00	0.00	66.41	0.00	0.00	0.00	53.97	0.00	1.20	0.00	0.00	5.30	0.00	1.32	131.92
6 Fishery	0.00	0.00	0.00	0.00	0.00	1,068.01	0.00	0.00	703.63	0.00	0.09	0.00	0.00	131.22	0.00	14.97	1,917.93
7 Forestry	0.12	0.32	0.27	0.08	1.22	0.40	21.31	1.67	4.41	100.65	123.69	146.29	0.00	2.20	0.01	0.25	402.90
8 Mining and quarrying	0.00	0.00	0.00	0.15	0.16	0.76	0.00	1.07	0.16	0.09	76.78	9.66	0.00	0.00	0.00	0.33	89.16
9 Food products and beverages	0.00	0.07	0.09	0.06	0.00	0.00	0.01	0.00	78.34	1.01	10.58	13.18	0.00	215.37	19.06	43.64	376.83
10 Textiles and apparel	3.00	8.88	15.15	1.47	4.26	33.47	13.37	0.03	1.17	3,383.10	27.83	988.13	8.60	27.37	77.55	67.32	3,722.86
11 Other manufactures and utilities	510.57	128.28	135.03	117.76	156.82	484.30	74.28	17.63	39.13	821.61	861.61	0.33	45.72	42.17	855.53	907.05	6,226.13
12 Construction	1.28	1.03	0.25	0.29	15.31	2.41	1.52	5.64	4.60	44.69	25.04	15.61	86.25	2.31	2.88	48.61	160.07
13 Trade	517.52	194.83	33.16	58.67	187.48	438.34	90.41	0.56	53.54	377.61	94.07	29.99	3.88	0.00	0.00	0.00	2,046.19
14 Hotels and restaurants	0.00	0.00	0.10	1.75	0.40	0.54	7.57	0.07	0.63	59.42	9.48	9.24	93.83	2.89	48.23	103.55	344.08
15 Transportation and communication	692.18	335.16	36.94	40.49	94.23	106.43	73.32	12.02	53.59	113.56	57.51	1,212.59	64.44	5.17	286.33	104.43	2,105.77
16 Other services	8.35	3.83	6.10	1.98	1.01	23.59	3.10	0.95	2.45	225.96	21.82	9.24	59.17	5.58	49.50	393.66	816.29
Total Intermediate Input	2,134.11	853.56	269.03	243.31	527.31	2,162.74	289.50	39.65	1,746.44	5,231.95	1,427.57	1,212.59	361.91	707.60	1,339.27	1,698.00	20,244.54
Wages and Salaries	112.20	30.04	30.11	13.89	55.61	59.81	104.74	9.84	12.82	572.49	143.77	230.61	22.31	276.14	77.01	1,156.36	2,907.76
Operating Surplus	901.16	352.91	310.92	178.62	533.09	1,158.86	55.10	3.74	54.53	324.00	103.16	133.70	1,196.11	46.40	415.15	407.66	6,175.11
Depreciation	393.77	194.43	134.33	101.28	259.55	515.75	250.36	32.00	311.84	1,395.19	424.80	691.62	242.62	388.04	648.56	1,123.88	7,108.03
Indirect Taxes less Subsidies	68.01	30.97	80.32	11.55	59.89	94.55	14.33	3.93	89.46	76.69	157.42	60.59	274.83	86.83	94.32	8.38	1,212.16
Total Value Added	1,475.15	608.34	555.68	305.34	908.14	1,828.97	424.53	49.51	468.66	2,368.38	829.14	1,116.53	1,735.96	797.41	1,235.04	2,696.28	17,403.06
Total Input	3,609.26	1,461.91	824.71	548.65	1,435.45	3,991.72	714.03	89.16	2,215.10	7,600.32	2,256.71	2,329.12	2,097.87	1,505.01	2,574.31	4,394.28	37,647.60

	Total Intermediate	Private Consumption	Government Consumption	Public Fixed Capital Formation	Private Fixed Capital Formation	Export	Domestic Final Demand	Domestic Demand	Final Demand	Demand	Import	Total Final Demand Sector	Total Output
1 Paddy	1,182.12	2,133.33	0.00	0.00	0.00	293.81	2,133.33	3,315.45	2,427.14	3,609.26	0.00	2,427.14	3,609.26
2 Cereals, beans, and vegetables	230.74	1,264.28	0.00	0.00	0.00	0.00	1,264.28	1,495.02	1,264.28	1,495.02	33.11	1,231.17	1,461.91
3 Cash crops	275.22	0.00	0.00	0.00	0.00	549.49	0.00	275.22	549.49	824.71	0.00	549.49	824.71
4 Other crops	216.33	332.32	0.00	0.00	0.00	0.00	332.32	548.65	332.32	548.65	0.00	332.32	548.65
5 Livestock	131.92	934.15	0.00	0.00	469.97	0.00	1,404.12	1,536.04	1,404.12	1,536.04	100.59	1,303.53	1,435.45
6 Fishery	1,917.93	2,073.79	0.00	0.00	0.00	0.00	2,073.79	3,991.72	2,073.79	3,991.72	0.00	2,073.79	3,991.71
7 Forestry	402.90	239.55	0.00	0.00	0.00	71.58	239.55	642.45	311.13	714.03	0.00	311.13	714.03
8 Mining and quarrying	89.16	0.00	0.00	0.00	0.00	0.00	0.00	89.16	0.00	89.16	0.00	0.00	89.16
9 Food products and beverages	376.83	1,885.48	0.00	0.00	0.00	262.01	1,885.48	2,262.31	2,147.49	2,524.32	309.22	1,838.27	2,215.10
10 Textiles and apparel	3,722.86	364.67	0.00	5.85	6.05	6,665.34	376.57	4,099.43	7,041.91	10,764.77	3,164.45	3,877.46	7,600.32
11 Other manufactures and utilities	6,226.13	735.21	0.00	140.04	1,458.90	215.97	2,334.15	8,560.28	2,550.12	8,776.25	6,519.54	-3,969.43	2,256.71
12 Construction	160.07	0.00	0.00	1,033.77	1,193.27	0.00	2,227.04	2,387.11	2,227.04	2,387.11	57.99	2,169.05	2,329.12
13 Trade	2,046.19	0.00	0.00	0.00	0.00	51.68	0.00	2,046.19	51.68	2,097.87	0.00	51.68	2,097.87
14 Hotels and restaurants	344.08	330.41	0.00	0.00	0.00	900.37	330.41	674.48	1,230.78	1,574.86	69.84	1,160.94	1,505.01
15 Transportation and communication	2,105.77	646.32	0.00	0.00	0.00	831.13	646.32	2,752.09	1,477.45	3,583.23	1,008.91	468.54	2,574.31
16 Other services	816.29	2,712.10	975.00	18.81	38.10	308.12	3,744.02	4,560.31	4,052.13	4,868.42	474.14	3,577.99	4,394.28
Total Intermediate Input	20,244.54	13,651.60	975.00	1,198.47	3,166.29	10,149.50	18,991.36	39,235.90	29,140.86	49,385.40	11,737.80	17,403.06	34,647.60
Wages and Salaries	2,907.76												
Operating Surplus	6,175.11												
Depreciation	7,108.03												
Indirect Taxes less Subsidies	1,212.16												
Total Value Added	17,403.06												
Total Input	37,647.60												37,647.60

tio) is an indicator which shows how much gross domestic income is induced by one unit of final demand for an industry. A matrix derived by multiplying the Leontief inverse matrix by the value added ratio determines the income inducement structure. Supposing that $\widetilde{V}$ is a diagonal matrix of the value added ratio, the value added multiplier is the column sums of a matrix $\widetilde{V}\left\{I-(I-\widetilde{M})A\right\}^{-1}$.

Results and discussion

1. Results of skyline analysis
(1) Structure of the Cambodian economy by skyline chart

Fig. 1 is derived from Table 1. Each sector's width shows share of domestic production. Each sector's height shows latent, necessary domestic production level to meet final demand including export. Dark shaded areas show substitution of domestic production by import and light shaded areas show actual domestic production. Because 100% on the vertical axis denotes a self-sufficient production level, some sectors whose actual domestic production is higher than 100%, should export their products.

From the horizontal axis, *Textiles and Apparel* (20%), *Fishery* (10%), and *Paddy* (9%) have larger production. Among them, *Textiles and apparel* has a tremendously large share.

The vertical axis shows that *Textiles and Apparel* and *Hotels and Restaurants* export large amounts of products and services. The former produces 500% of the self-sufficiency level. The latter produces 200%. On the other hand, domestic production of *Other manufactures* including vehicles and machinery is less than 20%. Cambodia's international trade pattern is that the country gains foreign currency by exporting only fiber products or tourism services, and buys vehicles, machinery, etc.

Textiles and Apparel has great presence both in production share and export. In this context, Cambodia's economy largely relies on the industry.

(2) Comparison with Thailand

Thailand is the most developed of the Lower Mekong Basin countries. Structural status in the economic development process of both countries were compared.

In Thailand's chart (Fig. 2), production shares of *Agriculture* and *Food products* in 1980 were relatively large. Their production exceeded the self-sufficiency level and the two were export sectors in the early development stage. In 1990, *Agriculture* declined both in the production share and export amount. Instead, *Fiber industry* grew and became an export sector. In 2000, *Paper industry* joined export sectors. In addition, almost all sectors realized high self-sufficiency. For 20 years from 1980, the number of sectors whose production was over the self-sufficiency
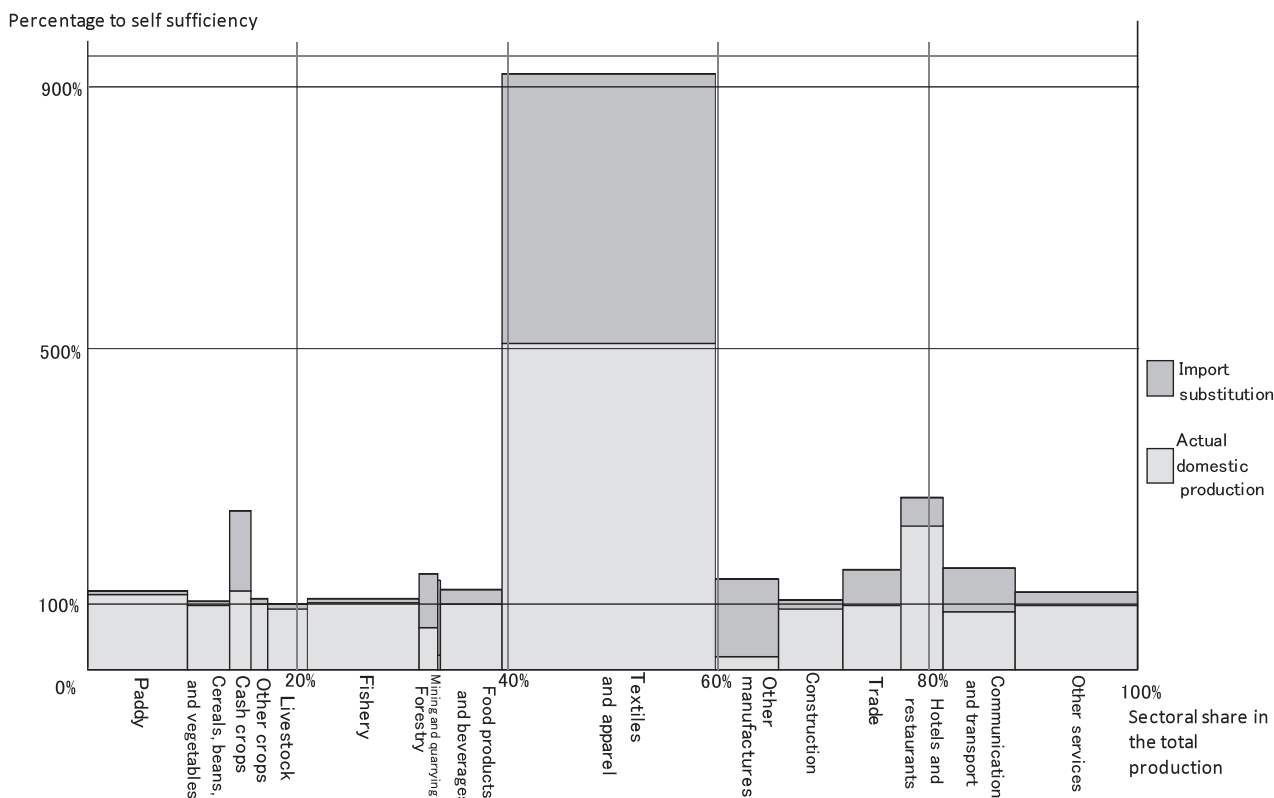
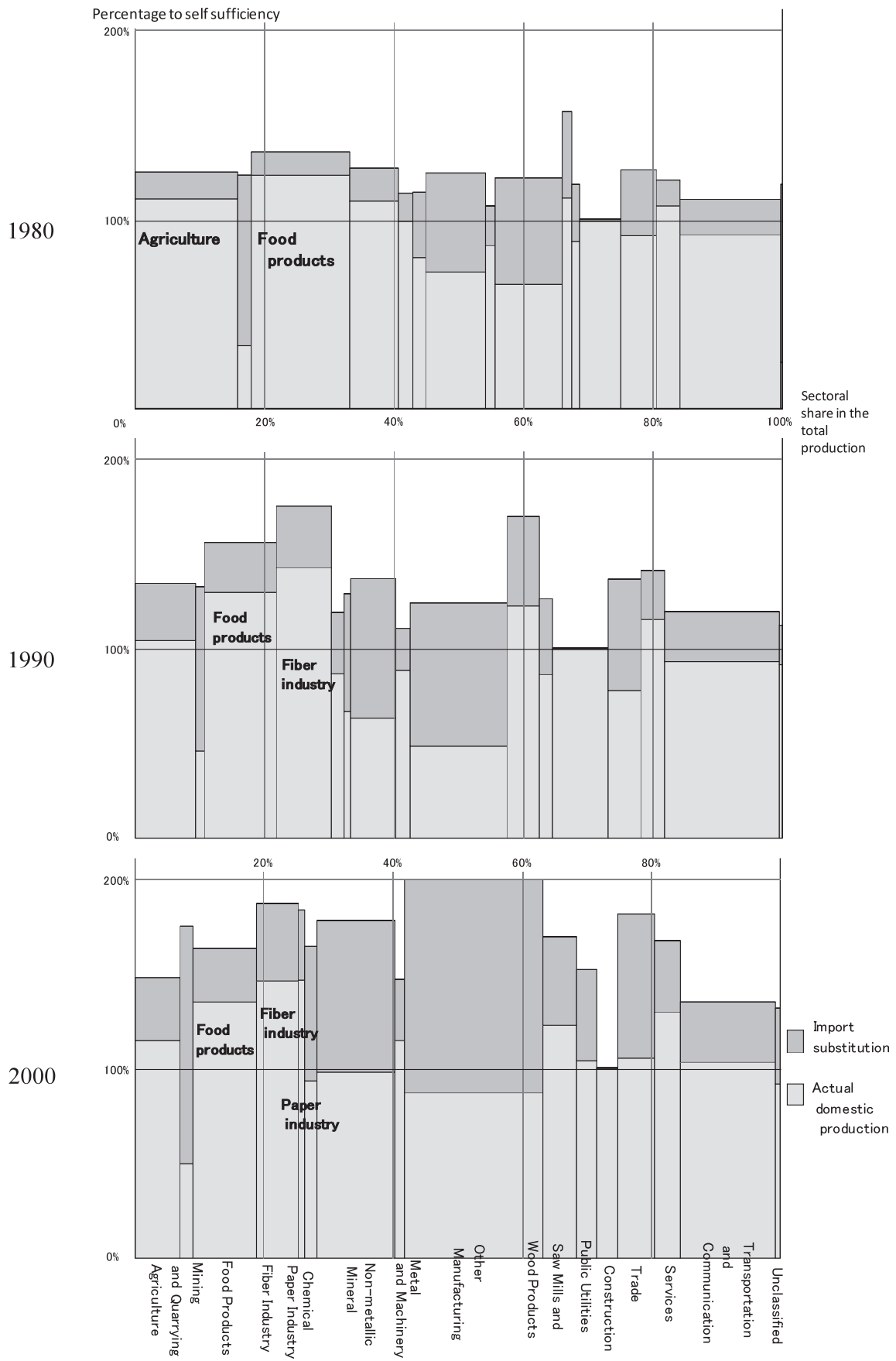

Fig. 1. Skyline chart of the Cambodian economy

Fig. 2. Skyline charts of Thailand

level, had increased from 5 to 10. In Fig. 2, the flying geese pattern[1] of development related to the successive shift of leading sectors in an economy is found. In this development pattern, capital accumulation contributing to comparative advantages is one of the important driving forces[4]. Profit from export sectors brings up the next export sectors and past leading export sectors are replaced by new leading export sectors. Through such relayed growth, macro economy grows. Though this is no longer the only development pattern, it is still a good example of economic take-off.

Fig. 1 shows that Cambodia's present leading export sector is *Textiles and Apparel* of light industries. Exports from agricultural sectors are very small. Self-sufficiency of manufactured goods is still very low. These facts imply that the present situation is similar to that of Thailand in 1990. If we expect the same development pattern as Thailand to keep economic growth of Cambodia, the economy needs to gain enough profit from *Textiles and Apparel* to invest in a next leading sector. That kind of potential will be discussed in the next section.

2. Results of key sector analysis

Table 2 shows the output multiplier and value added multiplier derived from Table 1. Highly valued sectors in output multiplier are *Food products and Beverages*, *Hotels and Restaurants*, *Fishery*, *Cereals Beans and Vegetables*, and *Paddy*. These sectors have strong power to induce other sectors production. Their growth will be accompanied by that of many other sectors. Such broad-based growth is expected to increase labor demand and thus

to distribute income to broad groups including the poor. Therefore, broad-based growth is important for poverty reduction.

Highly valued sectors in value added multiplier are *Trade*, *Hotels and Restaurants*, *Livestock*, *Fishery*, and *Forestry*. These sectors are able to induce higher domestic income than the other sectors. Therefore, in order to gain larger profit for future domestic investment, it is preferable to bring up these sectors as export sectors.

Table 2. Output multiplier and value added multiplier of Cambodia

	Industrial sectors	Output multiplier	Value added
1	Paddy	1.537	0.714
2	Cereals, beans, and vegetables	1.557	0.730
3	Cash crops	1.218	0.798
4	Other crops	1.319	0.746
5	Livestock	1.315	0.836
6	Fishery	1.641	0.808
7	Forestry	1.343	0.806
8	Mining and quarrying	1.316	0.710
9	Food products and beverages	2.195	0.792
10	Textiles and apparel	1.329	0.477
11	Other manufactures and utilities	1.425	0.601
12	Construction	1.261	0.607
13	Trade	1.157	0.904
14	Hotels and restaurants	1.720	0.842
15	Transport and communication	1.278	0.606
16	Other services	1.275	0.751
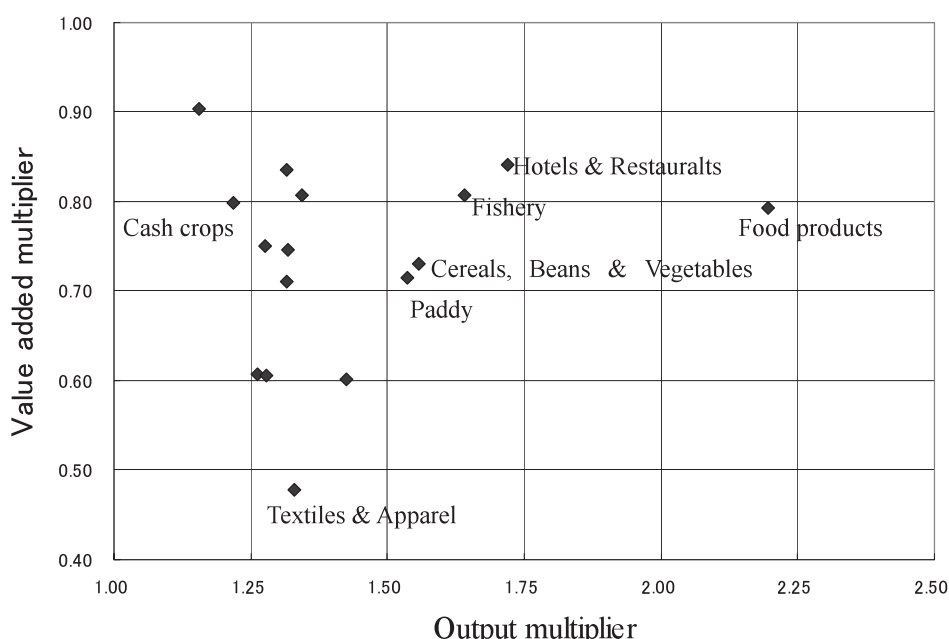
Fig. 3. Scatter diagram of output multiplier and value added multiplier of Cambodia
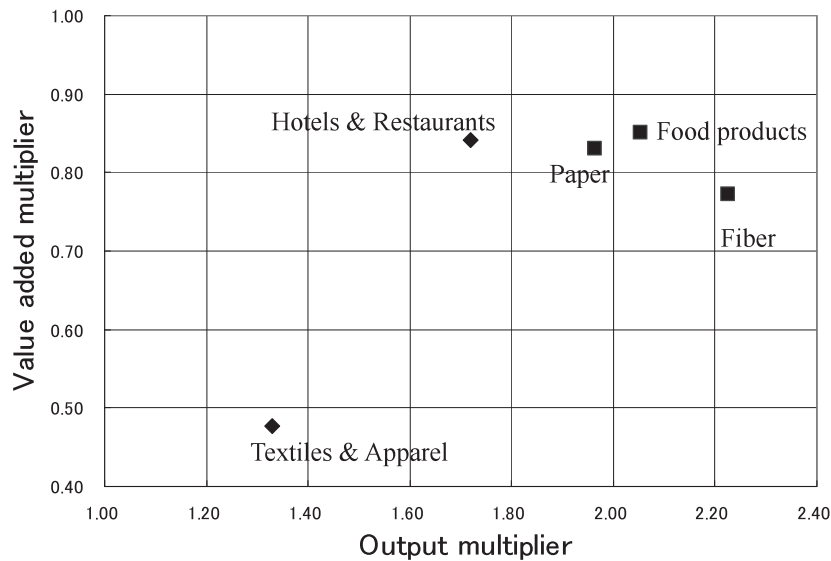
Fig. 4. Scatter diagram of leading export sectors of Cambodia and Thailand
◆ Cambodia 2003 export industries, ■ Thailand 1990 export industries

As mentioned above, pro-poor growth is an important target in developing countries. Judging from the characters of both multipliers, sectors with high values in both multipliers are preferable for pro-poor growth. Fig. 3 is the scatter diagram of Cambodia's multipliers. Preferable sectors are *Food products*, *Hotels and Restaurants*, *Fishery*, *Cereals Beans and Vegetables*, and *Paddy*. This result shows that agriculture, fishery, and related food industry, inducing both wide and high distribution of domestic income, can play an important role in realizing pro-poor growth in Cambodia.

Fig. 3 also shows the inefficiency of *Textiles and Apparel* in both multipliers while the sector exports large amounts of products as shown in Fig. 1. This property may cause the failure in "the flying geese pattern". Fig. 4 compares export sectors of Cambodia and Thailand. *Textiles and Apparel* of Cambodia has much lower values in both multipliers, compared to Thailand's three export sectors. Both multipliers of the sector are about 60% of Thailand's fiber industry. This is because Cambodia's fiber industry needs to import much of the textile material, as shown in Fig. 1. Therefore, Cambodia's largest export sector is unlikely to produce enough profit to foster future leading sectors. How the Cambodian economy secures enough domestic investment funds is a problem for its development.

Conclusions

Textiles and apparel is the largest industry in the Cambodian economy and its production share amounts to 20%. *Fishery*, and *Paddy* are also large. Their production shares are 10% and 9%. The economy gains foreign currency by exporting *Textiles and Apparel* and services of *Hotels and Restaurants*, and it imports manufactured commodities including vehicles and machinery. The production level of *Textiles and Apparel* reaches 500% of the self-sufficiency level. The economy largely relies on the industry.

Compared with the Thai industrial structures, the present Cambodian situation is similar to the Thai situation in the 1990s'. If we expect the same development pattern as Thailand to keep economic growth, the Cambodian economy needs to gain enough profit from export to invest in a future export sector. However, Cambodia's domestic profit from one unit of fiber product export is only 60% of Thailand's fiber industry in 1990. How to secure domestic investment funds is a problem.

Conditions of preferable industries for pro-poor growth are to strongly induce both wide and high distribution of domestic income. *Food products*, *Hotels and Restaurants*, *Fishery*, *Cereals Beans and Vegetables*, and *Paddy* meet such conditions. Agriculture, fishery, and food industry have high potential for pro-poor growth in Cambodia.

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