Development and Constraints of Food Industries in Japan

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Abstract

The development of the food-processing industries in Japan can be expressed in terms of changes from traditional food production for self-sufficiency during the pre-modern period to the production of modern differentiated products by the introduction of modern technologies that have been imported, adapted, and developed in their own ways. Thus, today there is a coexistence of both traditional and modern types of producers supplying their own products in the market. This line of development is due to the constraints on the conditions of raw materials suppliers, as well as changes in consumption patterns of consumers.

Japanese food-processing firms are generally small in terms of number of employees and value of output per unit. Among the developed countries, Japan has the largest number of food-processing firms of which 95.1% consist of small-scale ones. These small firms are located in many prefectures, and have served local consumers and households. On the other hand, there are small numbers of exceptionally large establishments, such as flour mills, sugar and fish-processing plants. They receive stable supplies of raw materials in large amounts, and the procurement problem is relatively minor. Although recently the number of small-scale firms has tended to decrease, the characteristics of structural dichotomy in the industry still prevail strongly. As a result, the industry is confronted with many problems, such as high cost of production and relative disadvantage in trade with large retailers, in addition to raw materials supply problems, environmental concern related to the disposal and recycling of packages, and an increasing competition from other countries as Japanese currency has appreciated. The concept of food system is the most suitable for capturing the overall features of food industries. In this report we will discuss the development and constraints of the Japanese food industries in terms of food system.

Introduction

In Japan today, food-processing industries have attracted the attention even of intellectual communities, mainly because until a decade ago they had been neglected by policymakers, economists, and other groups. It is now being realized that a systematic approach is necessary to tackle the problems in and among the agricultural and food-processing industries, wholesale and retail trade, and food service industries. In this paper, we will discuss the development and constraints of food industries in Japan, focusing on food-processing industries since the 1960s.

The issues and problems of food-processing industries, such as the dichotomous structure (coexistence of few very large firms and many very small firms), relative disadvantage in trade

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between large retailers, dependency on import of raw inputs and procurement problems will be outlined. For that purpose, we will examine the geographical distribution of food-processing establishments, their relative importance in the manufacturing industries, production trends, productivity, employment, scale of production and sales concentration as well as technology. These problems and issues are strongly related to various changes in the demand from consumers and agricultural sector. It is, therefore, appropriate to analyze the development and constraints in adopting the concept of food system by following a systematic approach to food-related industries which are an essential part of the system, including agriculture and fisheries, food-processing, food service, wholesale and retail trade, consumer or household demand and foreign trade.

Emphasis will be placed on Japan's economic development as a key factor for the growth and development of the food system in Japan. Furthermore, the changes in the relative size of each industry within the structure of the food system depend on the income growth of consumers in the system; that is, for the development of the food industry, the demand side is more important than the supply side. In the next section, therefore, we will examine the performance of the food system and demand of the household sector before analyzing the food-processing industries.

Performance of the food system in Japan

As in the USA (Connor and Schiek, 1997), the food system has been one of the largest single economic activities in the Japanese economy since the end of World War II. Its importance in the national economy, however, has shown a declining trend over the past four decades due to its slower growth (about 2.5% annually) compared to the national GDP growth (4%) (Tokoyama and Egaitsu, 1998). The economic contribution of the food system to the national economy is shown in Table 1. The food system's value share in GDP was about 23% in 1965.

Table 1 Relative proportion of food system in the economy (%)

Year	1965	1970	1975	1980	1985	1990	1995
Food system value share in GDP (a)	22.8	na	18.6	17.1	15.9	13.4	na
Food system (b) employment share in all industries	33.6	28.7	24.1	22.2	21.0	18.7	18.2
Agriculture & fisheries	24.1	18.9	13.5	10.7	9.1	7.2	5.7
Other food industries (c)	9.5	9.8	10.6	11.5	11.9	11.5	12.5

Notes: (a) Includes value added from the industries defined in (b), but excludes the value of imported products.
(b) Agriculture: fisheries; food manufacturing; wholesale and retail food trade; and restaurants & catering.
(c) Food manufacturing, wholesale and retail food trade; restaurants & catering.
Sources: Estimated based on principal statistics of food industry.
Japan Food Industry Center, several issues, Japan Statistical Yearbook.
80 Nen'dai no Shokuhin Sangyo, Japan Ministry of Agri., Forestry and Fisheries, 1980.

The total output of the agriculture and fisheries sector contributed most to the food system. However, as the development stage of the economy became mature over the past twenty five-year period and Japan became one of the richest countries in the world, the value share of the food system in the national economy decreased to almost half (13.4%) of the GDP in 1990.

A similar trend can also be observed in the food system's employment share in the total national employment. The food system in 1965 accounted for about one-third (33.6%) of the national employment. It decreased to about 18% in 1995 but still provides the largest opportunities for job-seeking people in the nation. Among the components of the food system, the largest reduction was experienced by the agriculture and fisheries sector which decreased from 24.1% in 1965 to 5.7% in 1995, about one quarter of the 1965 level. On the other hand, the employment share of other food industries in the national total instead increased from 9.5% in 1965 to 12.5% in 1995. Thus, the role of the food-processing, food service, and other downstream industries in the food system has increased as important suppliers of job opportunities in the national economy.

Changes in household consumption pattern

At the end of World War II, Japan was hit by a serious shortage of food. At this early stage of the post-war economic development, the most important policy was to meet the demand for basic nutrients in the Japanese people's diet. Thus scarce resources were heavily allocated to the increase of the production of a staple food, rice. Individual and household consumers had no choice but to spend most of their income for purchasing rice and other basic foods such as wheat flour, oil and fat, and sugar. These foods were rationed by the Japanese government. However, as the Japanese economy continued to grow and per capita income increased from US $727 in 1965 to US $ 31,885 in 1995 (Table 3), the consumers' dominance in the markets has strongly prevailed. Theoretically speaking, when a higher income is obtained along with economic growth, consumers acquire more freedom in their spending, resulting in the decrease of Engel's coefficient as shown in Table 3. In addition, a higher income introduces a change in the consumption pattern, with a shift from a simple pattern of cereal-based consumption to animal-product-based consumption with a greater variety of food intake (see Table 2). This trend has been validated by many studies, such as those of Yamada (1993) and Senaur *et al.* (1991). In Japan, these changes in the dietary pattern are referred to as "westernization of dietary habits or life" (Fujita, 1995 and Japan Food Industry Center, 1993).

Besides the change in the Japanese diet, the life style and consumption patterns have also changed as the economy grew, resulting in a change of the utility function of the household. The utility function that represents consumers' taste and opportunity cost of cooking and preparation of foods at home changed due to such factors as urbanization, more employment opportunities given to housewives and the increasing number of nuclear families. Tokoyama and Egaitsu (1994) state that both income and relative prices of foods have lost their importance as a dominant factor in food consumption in Japan today. They argue instead that "the rise in the opportunity cost of labor (predominantly of wives) for household work is one of the most important factors that could have induced changes in food consumption, notably the shift towards more convenient types of foods."

Table 2 National average net food supply per capita in terms of nutrients

Item	Percentage distribution (%)					
	1965	1975	1980	1985	1990	1994
Total calories	2,158.8	251.7	2,561.5	259.2	2,636.7	2,626.6
Staple foods a)	63.1	51.7	49.3	47.5	46.4	45.5
Foods of animal origin b)	10.6	14.9	17.3	18.2	20.1	21.3
Sugar and sweets	8.0	10.4	9.6	8.8	8.4	7.9
Fats and oils c)	6.5	10.9	12.5	13.7	13.7	13.9
Others	11.8	12.1	11.3	11.8	11.4	11.4
Total protein (g)	75	80.2	83	84.6	87.8	88.9
Animal protein (%)	34.5	43.6	47.1	49.1	51.7	52.9
Fats (g)	44.3	63.9	72.6	78.6	83.3	85.5

Notes:
a) Including cereals (rice) ; potatoes; starchy and other staple foods.
b) Including meat, eggs, milk and fish; excluding butter, fallow and lard.
c) Fats and oils include both vegetable and animal origins.
Source: Principal statistics of food industry, Japan Food Industry Center, several issues.

Table 3 Ratio of expenditure on processed foods in household food consumption (%). Engel's coefficient, income per capita (US$), and urban population ratio (%)

Item	1965	1970	1975	1980	1985	1990	1995
Processed foods	44.0	44.6	46.6	46.4	46.8	48.5	50.1
Cereals	17.9	12.3	8.8	8.2	8.0	6.3	5.4
Fresh foods	30.8	33.2	33.3	31.6	30.1	28.8	27.3
Eating-out	7.2	9.9	11.3	13.8	15.1	16.4	17.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Engel's coefficient	38.1	36.0	34.4	29.0	27.0	25.4	23.1
Income per capita	727	1,584	3,632	7,190	8,851	19,142	31,885
Urban population ratio	67	71	75	78	76	77	*77

Source: Principal statistics of Food industry, Japan Food Industry Center, several issues.
Annual report on National Accounts, Economic Planning Agency, several issues.
Note: * 1993 data.

To confirm this assumption, we prepared Table 3 to examine the ratios of expenditure on processed foods and eating-out in household food consumption from 1965 to 1995. The share of eating-out increased from 7.2% in 1965 to 17.2% in 1995. In contrast, the ratio of expenditure on grains decreased from 17.9% to 5.4% in 1995. Two categories in the table are most affected by the rise in the opportunity cost of working members of the household, namely, the eating-out expenditure and the expenditure on processed foods. The total of these two categories increased from 51.2% in 1965 to 67.3% in 1995. This increase corresponds to the growth of the

urban population and the ratios roughly reflect the overall change in the life style and employment opportunities (in the urban areas) of the Japanese people. The supply side of the food industries has certainly responded to and restructured the organization to meet the consumers' change in lifestyle for food consumption. Table 4 shows basic statistics for the food service industries (restaurants and catering) to examine their performance in response to the increase of consumers' trend of eating-out. The number of establishments in these industries increased from 190,000 in 1964 to 528,000 in 1982. However, since 1982 the number has decreased slowly to reach a value of 474,000 in 1992. In terms of the number of employees, a constant growth is depicted in the statistics: from 783,000 persons in 1964 to 2,448,000 in 1992, due to the increase in the average size of the firms. The growth of sales is more pronounced, as it increased from ¥677 billion in 1964 to ¥13,135 billion in 1992.

Table 4 Basic statistics for food service industries (restaurant and catering) (a)

	Unit	1964	1970	1972	1974	1976	1979	1982	1986	1989	1992
Number of establishments	(1,000)	190	298	351	397	446	503	528	501	491	474
Number of employees	(1,000)	783	1,116	1,311	1,426	1,593	1,738	1,911	2,055	2,282	2,448
Sales	Billion Yen	677	1,621	2,253	3,373	4,890	6,583	8,361	9,720	11,156	13,134

Note: (a) Commercial feeding only.
Source: Shokuhin-sangyo Tohkei Nempoh, Japan Food Industry Center, 1996.

Performance of the food processing industries

The change in the consumption pattern previously outlined induced an increase in the development and supply of many types of processed foods, including traditional ones, that is, the demand side leads the supply side. A key to the success of the increasing supply of traditional foods depends on the country's technological development to mass-produce them. Successful examples can be seen in the manufacturing of tofu (soybean paste), shoyu (soy sauce), miso (fermented soybean paste), sake (rice wine), natto (fermented soybean), and tea. Formerly, these traditional foods were produced by a household for its own consumption, while they are now produced on a commercial basis by the adaptation of modern technologies. Thus the development of the food-processing industries in Japan reflects the changes from traditional food production for self-sufficiency during the pre-modern period to the production of modern differentiated products through the introduction of modern technologies that have been imported, adapted, and developed, when appropriate. Thus presently there is a coexistence of both traditional and modern types of producers supplying their own products in the local and national markets.

Fig. 1 shows the geographical location of food-processing industries in 1994. The ratios of food-processing industries to all manufacturing industries in 47 prefectures are estimated for the number of firms and in terms of output values. Prefectures are arranged in such a way that northern prefectures (Hokkaido, Aomori, Iwate, etc.) are placed in the far left; the prefectures

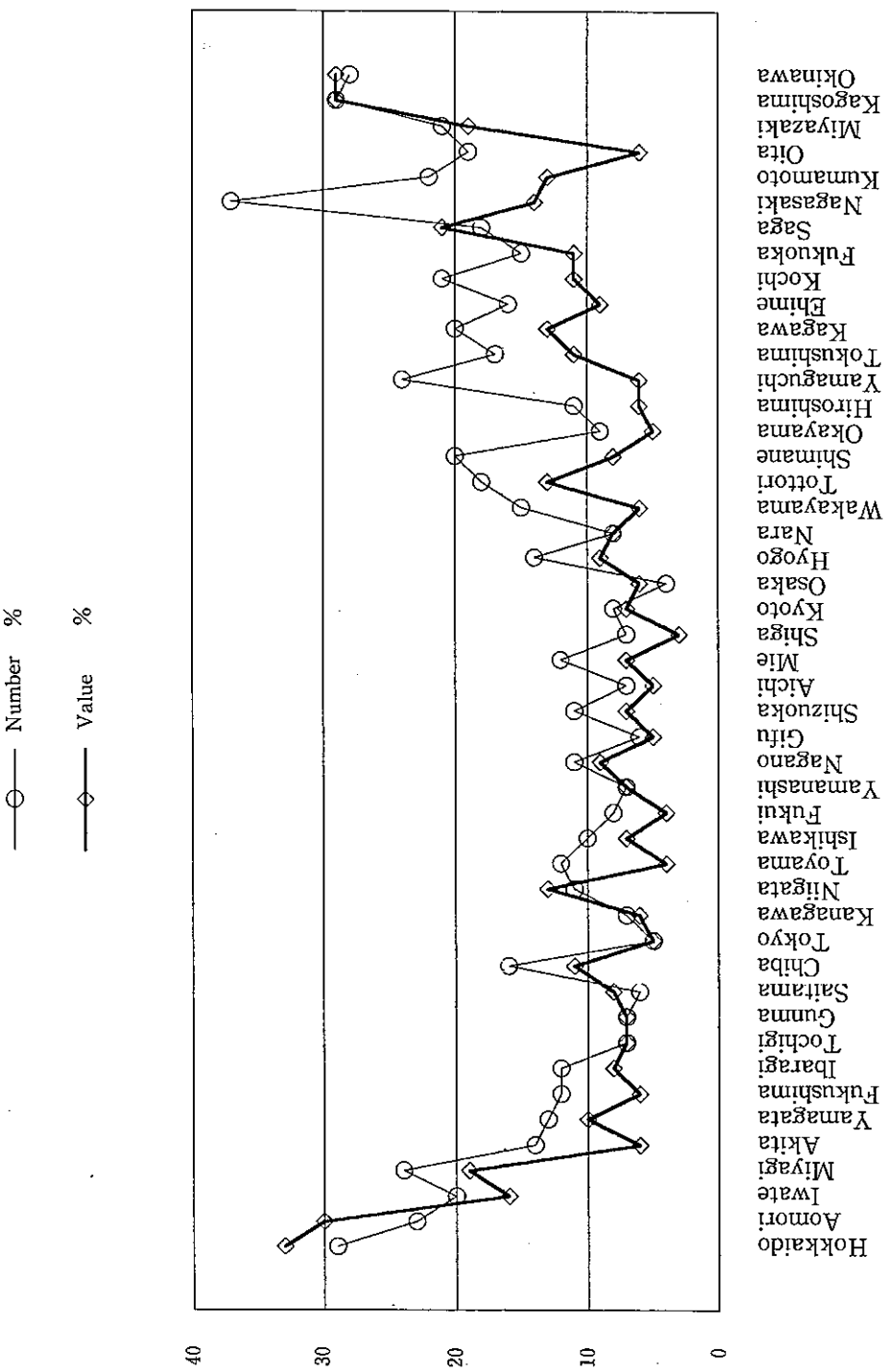

Fig. 1 Ratio of food processing industries to all manufacturing industries (1994)

in the central region (from Ibaraki to Wakayama) are placed in the middle; and the southern prefectures (Tottori, Shimane, Okayama, Hiroshima, and Yamaguchi prefectures, those in Shikoku and Kyushu Islands and Okinawa Prefecture) are placed in the far right in the Figure.

The Figure shows some interesting characteristics of the geographical distribution of the food-processing industries in Japan. First, the firms are widely dispersed throughout all the prefectures, and are present all over Japan. Second, the relative number of the food-processing industries in the central region is small, but it increases in the northern and southern prefectures. Third, the relative size of the food-processing industries compared with other manufacturing industries is small except in some prefectures, such as Hokkaido and Aomori. In relative terms, Nagasaki Prefecture has the largest number of food-processing firms (mostly in labor-intensive noodles and fish-processing production), but in terms of the firm' size, they are the smallest among the prefectures. Fourth, in relative terms, the food-processing firms in the southern region tend to show a much smaller scale of production compared to those in the North and the South (except those in Okinawa, Kagoshima, Miyazaki, and Saga prefectures). According to Suzuki (1996), these small and medium-sized food-processing firms located in many prefectures are in general demand-oriented industries rather than supply-oriented. He also stated that the difference in productivity among small and different industries in food processing is rather negligible, while regional or prefecture differences in productivity are large.

At the national level, the output share of the food-processing industries has remained constant among all the manufacturing industries even though the share of all the manufacturing industries has shown a declining trend as depicted in Table 5. Also, the decreasing trend of the share of the food-manufacturing industries in the GDP has fairly leveled off, implying that the food-processing industries in Japan have maintained a relatively stable production in the national economy, as indicated in the statistics in Table 6. Table 6 shows the index numbers of industrial production in all the manufacturing and food industries, as well as labor productiv-

Table 5 Basic statistics for food service industries (restaurant and catering) (%)

Year	Share of agriculture in GDP	Share of manufacturing in GDP	Share of food manufacturing in GDP	Value share of food manufacturing in all manufacturing industries
1970	6.1	36.0	na	10.4
1975	5.5	30.2	5.4	11.9
1980	3.7	29.2	3.8	10.5
1985	3.0	29.5	3.3	11.0
1990	2.5	28.1	2.4	10.2
1991	2.3	29.1	2.6	10.1
1992	2.2	28.0	2.6	10.8
1993	2.1	25.5	2.7	11.3
1994	2.1	24.5	2.2	11.6
1995	1.9	24.7	2.2	11.2

Source: Japan Statistical Yearbook, several issues.

Table 6 Index number of industrial production and labor productivity
(basec year : 1990=100)

Year	Index number				Labor productivity	
	All manufacturing industries	Food, beverages	Food	Beverages	All manufacturing industries	Food, beverages
1975	48.7	81.3	78.1	81.6	na	na
1980	67.6	91.1	88.3	92.7	61.7	98.7
1985	80.2	92.4	93.1	89.8	75.2	95.5
1990	100.0	100.0	100.0	100.0	100.0	100.0
1991	101.7	100.4	101.3	99.7	102.5	101.0
1992	95.5	100.9	102.7	99.5	97.0	99.7
1993	91.2	99.9	102.7	97.5	95.6	94.7
1994	92.0	100.3	100.1	10.2	98.4	91.0
1995	95.1	97.1	100.8	93.1	103.0	87.1

Sources: Annual Report on National Accounts, Economic Planning Agency, Japan several issues.
Nohrin-suisan Tohkei (Agri., Forestry, and Fisheries Statistics), Japan Ministry of Agriculture, Forestry and Fisheries, several issues.

ity in the industries. Compared to the trend of the index number of all the manufacturing industries, the index number of the food-processing industries (food and beverage) displays a fairly stable trend in the range of 81.3 at the lowest, to 100.4 at the highest. However, in the case of all the manufacturing industries, the index number of production jumped from 48.7 in 1975 to 101.7 in 1991. It then decreased to a range between 90 and 100 throughout the 1990s.

However, the performance in the case of labor productivity shows somewhat different characteristics. Although the range of productivity trend of the food-processing industries is smaller than that of all the manufacturing industries, the trend in labor productivity of the food-processing industries reflects rather a stagnation or decline of the industries. This is because we can argue theoretically that a slower growth in productivity implies a slower growth in technological improvements for the production of processed foods, that will lead to stagnation in value-added activity. According to the statistics shown in Table 6, the labor productivity of the food-processing industries has been constantly decreasing since 1991, whereas the productivity of all the manufacturing industries had decreased from 1991 to 1993, but has rebounded since 1993. One of the reasons for the slow growth in technological innovations can be explained by the lower expenditure for R & D (research and development). According to Tokoyama and Egaitsu (1998), the food-processing industries spent only 1.01% of the ratio of R & D expenditure over the total sales value in 1993. This ratio is very low compared to those of the textiles and clothing industry (1.98%), pharmaceutical industry (5.45%), and electrical equipment industry (6.04%).

We have already mentioned that the production index of the food-processing industries has exhibited a declining trend since 1992, mainly due to the prolonged recession in the economy

that started around 1990 and is still persisting. Thus the sluggish demand of the consumers has affected all the manufacturing as well as the food industries. The number of workers in the food-processing industries also decreased from 128,000 in 1990 to 124,000 in 1994 (Table 7), even though the national level of employment increased by about 3% in the same period. However, from 1990 to 1995 the negative impact on the employment was minimum (-3%) for the food-processing industries compared to all the manufacturing industries (-12%). The last two columns of Table 7 show that the relative wage level of the food industries is much lower than that of other industries (except for agriculture), and the difference became more pronounced from 1975 to 1995. These differences may be attributed to the labor-intensive characteristic and small production scale of the food-processing industries. Thus to overcome this problem, further technological improvement is necessary for product innovation (for development of new products) as well as process-innovation (manufacturing).

Table 7 Employment and wages

Item		1975	1980	1985	1990	1995	Remarks
National employment	(10,000)	5,223	5,536	5,807	6,249	6,457	
Total labor force		5,323	5,650	5,963	6,384	6,666	
Manufacturing workers	(1,000)	1,130	1,093	1,154	1,179	1,042	(a)
Food, beverages & tobacco	(1,000)	117	116	122	128	124	(a)
of which:							
Food		101	101	107	114	111	(a)
Beverages & tobacco		15	13	13	13	11	(a)
Wage rates (all industries)							
monthly (1,000yen)	(AI)	177	263	317	370	409	
All manufacturing workers							
monthly (1,000yen)	(AM)	164	245	300	352	391	
Food manufacturing workers							
monthly (1,000yen)	(FM)	147	208	236	263	286	
(FM) / (AM)	%	90	85	79	75	73	
(FM) / (AI)	%	83	79	74	71	70	

Note: (a) 1994 data for 1995
Source: Japan Statistical Yearbook, 1991 and Principal Statistics of Food Industry, several issues.

It is commonly argued that the Japanese food-processing establishments are small in terms of value of output per unit and number of employees. Among the developed countries, Japan has the largest number of establishments of which 95.1% are small-scale ones (firms with less than 100 employees) (Table 8). On the other hand, there are a small number of exceptionally large establishments, such as flour mills, sugar and fish-processing plants. They receive stable supplies of raw materials in large amounts, and the procurement problem is relatively minor. Although recently the number of small-scale establishments have tended to decrease, the characteristics of structural dichotomy in the industry still prevail strongly as shown in Table 8. From 1984 to 1994, the proportion of very small establishments with less than 10 employees decreased from 71.93% to 50.63%, respectively, while that of medium-sized establishments (with

Table 8 Size distribution of food processing plants, 1984 and 1994

Size category (number of employees)	1984		1994	
	Number of plants (number)	Proportion in category (%)	Number of plants (number)	Proportion in category (%)
4−9	57,942	71.93	23,567	50.63
10−99	20,794	25.80	20,700	44.47
100−299	1,565	1.94	1,895	4.07
300−499	195	0.20	264	0.57
500−999	83	0.10	104	0.22
1,000 or more	20	0.03	19	0.04
Total	80,599	100.0	46,549	100.00

Sources: Census of Manufactures, the Ministry of International Trade and Industry.

more than 10 but less than 1,000 employees) increased. Furthermore, unlike in the USA (Connor and Schiek, 1997), the number of very large establishments with more than 1,000 employees decreased slightly, from 20 in 1984 to 19 in 1994. These three facts together seem to support the comment made by Tokoyama and Egaitsu (1998) that there is a "leveling-off of the size difference" in the industry. If this trend continues in the future, stability in the industry structure may increase.

Table 9 Value-added and size of the food processing industries, 1994

	Rank industry group	Value-added ratio (a) (%)	Value-added (Million Yen)	Ranked by value of shipments
1	Ice making	62.4	26,781	15
2	Bread and confectionery	51.6	2,223,238	4
3	Seasoning	50.0	892,075	8
4	Solt drinks	42.9	902,063	7
5	Others	39.6	2,010,419	1
6	Vegetable products	37.5	356,071	11
7	Sugar	33.2	204,246	14
8	Fats and oil	32.0	236,682	12
9	Fish products	30.5	1,271,206	5
10	Livestock and dairy products	28.4	1,372,111	2
11	Alcoholic beverages	27.5	1,236,441	3
12	Tea and coffee	27.2	172,221	13
13	Feedstuffs and organic fertilizer	21.7	21,447	10
14	Refined cereals and flour	18.9	37,726	9
15	Tobacco	14.7	370,090	6

Notes: (a) Value-added ratio = (Value added/Production value) ×100.
Source: Estimated based on Principal Statistics of Food Industry, 1996, Japan Food Industry Center.

A further analysis of the structure of the food-processing industries can be conducted by examining Tables 9 and 10 which show a classification of industry groups by the intensity of value-added (value-added ratio) and Hirschman-Herfindahl Index (sales concentration) of selected products. In Table 9, the ice making group ranks first because ice-making requires a minimum level of raw materials cost. The bread and confectionery, seasoning, and other groups (cookies and crackers, cup-noodles or pasta, etc.) are on top of the list because they are highly processed and highly differentiated products that are convenient for consumers. Their value-added margins are very high.

In Table 10, product groups are ranked by the Hirschman-Herfindhal Index. The index ranges from 10,000 to 0 : if it is close to 10,000, a monopoly exists in the market, and if it is close to 0, the product market is very competitive. The market for brandy is highly monopolized, and other products such as whiskey, instant coffee, curry roux, mayonnaise and dressing,

Table 10 Sales concentration in the food processing industries by selected products

Products	Share of Japanese market controlled by top firms				Hirschman-Herfindahl index,1992 (a)
	1984		1992		
	Top 3	Top 10	Top 3	Top 10	
Brandy	77.9	96.7	96.0	99.7	7,371
Whiskey	91.3	98.5	98.8	99.9	6,338
Instant coffee	99.8	100.0	98.3	100.0	5,194
Curry roux	89.1	98.1	92.3	99.2	4,934
Mayonnaise & dressing	89.6	99.9	86.9	99.8	3,965
Monosodium glutamate	82.5	100.0	83.9	100.0	3,445
Beer	89.8	100.0	91.7	100.0	3,417
Modified powdered milk	92.7	100.0	94.0	100.0	3,077
Cheese	74.5	97.8	73.0	98.2	2,501
Fish-meat (ham · sausage)	74.5	96.8	80.3	99.7	2,439
Instant Chinese noodles	67.4	95.3	66.2	98.6	1,974
Powdered milk	72.0	92.9	71.0	91.9	1,859
Butter	62.9	84.5	67.5	86.2	1,782
Instant noodles	64.0	91.9	60.6	90.0	1,597
Bread	35.8	57.8	50.5	56.8	1,325
Soy sauce	40.0	51.7	43.3	58.4	949
Ha · sausage	39.8	67.9	40.3	66.1	704
White sugar	31.6	75.0	31.5	75.9	631
Milk	37.9	54.6	35.3	55.7	554
Biscuits · crackers	22.5	46.1	25.0	55.7	359
Miso	16.1	37.9	24.0	44.7	289
Sake	9.9	20.7	10.6	25.0	65

Note: (a) Theoretically, the values range from 0 (competition) to 10,000 (monopoly).
Source: Principal Statistics of Food industry, Japan Food Industry Center, 1987 and 1996.

monosodium glutamate, beer, and modified powdered milks are listed in the top 8 with oligopolistic features. Their indices range from 3077 to 7371, which are very high compared to those in the USA (Connor and Schiek, 1997). In time-series data of 15 top-product groups, more products have increased their sales concentration (by top firms of 3 and 10) than decreased it. The same conclusion can be drawn in the case of the lowest 7 products and this trend is usually related to mergers and acquisition. The groups of products with a lower sales concentration by the top 3 or 10 firms can generally utilize simple technologies, unlike the highly sophisticated technologies used in the products listed in the top.

Some constraints of the food-processing industries

Along with the development of the Japanese food system associated with the economic development and increase of income due to the appreciation of the Japanese currency, the food-processing industries have encountered problems such as raw materials supply and high cost of production. Factors causing these problems are the sluggish growth and structural problems of Japanese agriculture. Since the major raw inputs used in the food-processing industries are food materials supplied by agriculture, the Japanese food processors deal with relatively expensive agricultural commodities, i.e., raw materials costs are very high. Thus, the industry started to look for imports of raw materials from other countries.

Table 11 partly shows the situation in terms of import dependency of raw materials for food processing. In the case of maize, there is a complete dependency on imports, while in the case of soybeans and wheat the dependency level exceeded 90 % in 1994. Raw inputs for oils and fats as well as starch also show a very high dependency and these figures have been increasing. In contrast, consumers' dependency on imports of processed foods is rather low, as

Table 11 Import dependency of processed food for final consumption and of raw materials for processing (%)

Import dependency of processed food for final consumption				
Item \ Year	1975	1980	1985	1990
Import over final consumption	5.2	6.5	2.8	7.2

Import dependency of raw materials for processing			
Item \ Year		1985	1994
Maize, Kaoliang		100	100
Soybeans		95	98
Wheat		86	91
Raw sugar		66	71
Commodity class			
Raw inputs for oil and fats		95	97
Raw inputs for starch		81	88

Source: Principal Statistics of food industry, JFIC, 1987, 1996.

shown in the Table. However, the percentage of half-processed or intermediate-processed foods for firms' input has shown a rapid increase. According to Kato (1990), these processed foods for inputs recorded an annual growth of about 36%, 37%, and 47% in 1986, 1987, and 1988, respectively. These imports certainly compete with domestically produced commodities and products. Kato argues that there has been a lack of suitable agricultural and food policies to address the problems in Japan. In fact, other analysts also point out that there is no food policy itself in Japan (Ogura, 1987). One of the alternatives for the industry to address the problem is to promote foreign direct investment or a globalization of production. According to the Japan Food Industry Center (1993), overseas direct investment in the food-processing industries has increased, and a total of 1,632 firms invested between 1951 and 1989. The total amount invested reached US $ 3265 (million) in the same period.

In addition to the problems mentioned above, the food-processing industries are faced with a relative disadvantage in trade between large retailers (supermarkets and convenience stores), high expenditure for advertising, very low level of processed food exports from Japan, and problems that are mainly related to the disposal and recycling of packages. We have already mentioned that in the food system, the consumers' feedback or response in the market is very important. The food sectors or industries that have a command over information on the consumers' shopping behavior by using POS (points of sales) are large retailers and convenience stores. Thus in trade they are in a better position than the food-processing firms with a medium and small size (Japan Food Industry Center, 1993).

In the case of advertising expenses incurred by the food-processing industries, it is somewhat surprising to note that the food industries spent about three times the amount spent by the automobile and related industries in 1994. The amount was about five times that of electric equipment-related industries, which implies that the competition for the market share among the food-processing firms is very severe. Since they produce similar products, the firms have to differentiate their new products from those of others. The problem is that the marginal return of each output from the activities of advertising is very small due to the low sales value of the individual products. Thus it appears that too many resources are devoted to non-productive activities.

Even though there is a harsh competition in the domestic market, it seems that the Japanese food processors make very few efforts and devote few resources in the foreign market. This statement can be supported by the size of food exports and the deficit in the trade balance of foods. In 1990, the value of exports was only about 4% of the value of imports, and it has been decreasing since. In addition to some traditional foods, food processors in Japan could export other high value-added products if more resources were invested for research on new product development. According to Watanabe (1995), the processing technologies for some Japanese traditional foods have three advantages over technologies for other newly developed foods. The first advantage is the moderate chemical or physical treatment of traditional foods, which secures food safety and nutritional value. The second advantage is the utilization of salting and acidification methods for preservation, which are highly evaluated from the food safety and energy-saving standpoints. The third advantage of the technologies for the processing of traditional foods is the fact that since they do not require excess refinement, they do not lose a large amount of the vitamins and minerals contained in the original raw materials. To

promote the processing of traditional products, these advantages should be further emphasized in international markets.

Technological constraints of the food-processing industries

We have already mentioned that the Japanese food-processing industries spend less money on R & D compared to the other industries in Japan. In addition, although the situation has somewhat improved recently, Japan has had a deficit for a long period of time in the trade of food technologies with other countries. These facts seem to indicate that both technological changes and productivity of the food-processing industries had been stagnant during the 1980s and the early 1990s, based on the economic concept of total factor productivity (Uno and Sugimoto, 1996). However, the food-processing industries play an important role in the Japanese food system and the impact on the Japanese food security cannot be ignored. Improvement and development of new technologies must be actively and continuously promoted to meet the demand of the consumers as well as to sustain a sound growth of the Japanese food system. It is appropriate, therefore, to summarize some of the technological developments, problems, and constraints of the Japanese food-processing industries in the last part of the paper.

1 Research institutions and public policies --- Acording to Ishitani (1995), basic technologies, such as heating, drying, and concentration of food had been mainly developed by the private sector, namely by the food-related machinery producers from the postwar period to the early 1970s. As processing and shipping technologies improved, quality control and preservation for extended shelf-life also improved. These food-processing firms that have succeeded in applying and improving their technologies have enlarged their markets, and they became large establishments. Although such large firms have been able to invest for fundamental research and development (R & D) for technological innovation since they have enough funds accrued from their own sales, they tend to invest more for process-innovation research. Due to the uncertainty, the risk is higher in the investments for fundamental research than in those for process-innovation technologies.

In addition, most of the small and medium-sized food-processing firms also tend to avoid risky investments for fundamental research. This is because the size of the investment funds needed for the development of fundamental or frontier technology is too large compared to the values of annual sales. As a result, the total investment and the number of professional researchers hired for fundamental research by the private sector are small and limited, because small establishments dominate the industry in terms of number. Consequently, the reward from the investments is negligible in the Japanese food-processing industries as a whole. However, since the resulting information gained from R & D can be considered as "public goods", these investments are very important in terms of social benefits. Thus, the investment for fundamental research or technological innovations which is risky, has mainly been carried out by the public sector, namely the national research institutes and universities in Japan (their share accounts for more than 80% in the total investment for fundamental research).

Furthermore, the investment for applied research for innovative technologies accrued from fundamental research is also important, and the public sector (mostly research institutes of the local governments) plays a major role. In Japan, the private sector predominates in the

investments for research for the development of processed foods, because the returns from these investments are high.

It is thus obvious that we need to develop a system of technological transfer that will allow the private sector to have an access to the newly developed technologies by the public sector and the universities in order to promote and sustain a sound growth of the food industries. Also technical cooperation among these three sectors should be promoted further. For that purpose and to encourage research in the private sector, the Ministry of Agriculture, Forestry and Fisheries of Japan has implemented three measures (Fujita 1995) in addition to tax relief for R & D, as follows: Promotion of High-Technology Development by Technical Research Cooperatives (subsidies granted for research work), Support for Technical Development (subsidies granted for areas of applied research approved through the Food Industry Center and Regional Agricultural Administration Offices), and Training of Personnel and Technical Guidance (long- and short-term technical training for company employees). Regarding these measures, particularly the last one, it is hoped that the constraint of shortage in the professional work-force for research will be alleviated in the near future because the Ministry of Education of Japan has adopted a new direction for the policy relating to the college and university system. It plans to shift the emphasis on education from the undergraduate to the graduate level, and the number of students in the graduate schools have been increasing.

2 Safety and quality-related issues --- Both domestic and international factors are considered in the enactment of laws and regulations for safety and quality in the Japanese food industry. Since 1951, the Japanese Agricultural Standards (JAS) have been enforced. The document "stipulates the standard of specific processed foods with the aim to improve the quality of processed foods, to upgrade their production, to simplify their trade system, to promote consumption and use as well as to instruct right and appropriate labeling" (Watanabe, 1995). In labeling, "date of production" was changed to "date or period of appreciation" in 1995 to follow the international standard of the CODEX.

In 1996, however, three incidents occurred that endangered public health affecting more than 34,000 people in total, namely the outbreaks of epidemics of colon bacillus O157, *Salmonella*, and colitis germs. According to Kimura (1998), the government and the private sector involved in the Japanese food industries realized that the existing system of safety and quality control should be restructured along the lines of the enforcement of Product Liability Law enacted in 1995. Thus, an adaptation of the HACCP system recommended by the CODEX has been considered, and the Ministry of Health and Welfare started to enforce the new approval system for manufacturing and processing partly in the case of meat and dairy products in 1996. There is a worldwide trend to adopt the HACCP system, and the Japanese food-processing industries are no exception. Since Japan has many small and medium-sized firms, the industry will have to set up a management system that will enable small manufacturing plants to adopt the HACCP method.

In order to face the competition from other countries and to meet the trend of globalization, however, both ISO 9000 and 14000 series extending from upstream production to downstream shipments should also be considered in the Japanese food system. In this regard, it is encouraging to observe that the number of food-manufacturing plants which have been certified for the ISO 9000 series have increased in Japan (Kimura, 1998).

3 Genetic engineering in the food industries --- Roller *et al.* (1994) contend that "whilst the early developments in agricultural biotechnology may ultimately lead to reductions in the usage of agrochemicals and consequently to a less detrimental effect on the environment, they are unlikely to impinge on the food processor or consumer. Yet the technology of genetic engineering offers a great deal more than just a method for improving agronomic traits." In addition, the technology of genetic engineering is considered to be very effective to improve productivity, to alleviate worldwide food shortages and to save energy in the food production.

However, as in the other countries of Europe (Roller *et al.*, 1994), many of the Japanese consumers are also reluctant to accept genetically engineered foods, which may be due to the lack of information on safety issues given to consumers or could be the case of ill-informed public about biotechnology as Roller *et al.* contend. It is, therefore, important to develop a safety assessment technology to evaluate the processed foods using genetically engineered raw inputs. Another problem that should be addressed is to develop a technology enabling to determine rapidly whether the processed foods contain genetically engineered raw inputs, so that consumers, with sufficient information, can make their own decision when they purchase the processed foods.

By May 1997, the Ministry of Health and Welfare of Japan had guaranteed the safety of the following genetically engineered foods: soybeans, rapeseed, potatoes, and corn (Kimura, 1998). These foods were originally developed by firms in the USA, Britain, Canada, and Belgium. Although they are currently marketed mostly in these countries and Japan, it is likely that these genetically engineered foods will also be marketed in many other developed and developing countries as the demand for foods will exceed the supply in the world market in the 21st century.

4 Manufacturing and packaging technologies --- According to Watanabe (1995), both imported and domestically produced new technologies for food manufacturing have been introduced over the past decade. They have given an impact on food production in terms of efficiency and energy saving. Some of them include inspection technology for ripeness of fruits by direct optical determination, freeze-concentration of liquid foods without changes in the composition and flavor, freeze-grinding of raw materials that are rich in oil, high pressure treatment to kill microorganisms without changes of flavor, color and taste, new micro-grinding process using ceramics that does not affect the yield and quality of products, and others such as bioreactors, vacuum packaging and semi-aseptic packaging. Although the introduction of these new technologies has improved the quality of foods and contributed to the development of new materials and new processed foods, further development of technologies is still required in the field of packaging materials which can keep freshness and freeze-drying technology that will not lead to a loss of flavor.

On the other hand, the disposal and recycling of packages have become a serious environmental issue in Japan. Environmental concerns arising from market failure are very high today, and the food industries are no exception. "The Law for the Promotion of Recycling of Resources" and "the Waste Disposition and Scavenging Law " have been enforced, and the food industries must abide by these laws. Thus, in order to minimize the impact of the food industry on environmental degradation, Kimura (1998) suggests that new packages such as "bio-plastic" packages should be developed.

Conclusion

We outlined the development and constraints of the food-processing industries in Japan within the framework of the food system. The industries play a very important role in the Japanese food security and have many unique features, but there are also serious problems and constraints, such as the comparatively low productivity and the problem of procurement of raw materials as well as the problems in technological development. Even though we outlined some of these issues and technologies (we did not cover other important technological issues such as water pollution and control, storage and distribution, and energy management), we have not dealt with the issues of labor management. Management is another area that could improve productivity in the Japanese food industries. In addition, the industries have just started to be confronted with environmental issues. To address these problems, a sound food policy based on the food system as a whole should be enacted. Such a food policy may enable the Japanese food system to promote a balanced growth of agriculture and the food industries.

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