The Contribution of the Thai Food Industry to the Economy and Its Future Prospects in terms of Competitiveness

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Abstract

The Thai food industry is recently regarded as a key sector for income and employment generation and is expected to improve the rural-urban income inequality. This paper examines its contribution on Thai economy using an Input-Output (I-O) inducement analysis, and also its future prospects by looking into international competitiveness. The I-O analysis indicated that the food industry provided the strongest contribution to the economy in terms of production inducement to the whole economy, employment generation and foreign exchange earning. However, future prospects lies on the penetration into export markets, since its domestic market is too small to absorb the total production. Analysis on its export performance by Revealed Comparative Advantage (RCA) index and market shares in major export markets, and indication from export demand and supply equations have shown that the food industry's international competitiveness is declining. In review of many benefits of the food industry, the paper concludes by providing policy implications.

1. Introduction

Thailand underwent a severe economic downturn during the financial crisis in 1997 and 1998. During this period, the Thai government reviewed the past industrial development and the country export performance. According to the Industrial Restructuring Plan (1998) by the Ministry of Industry, the competitive position of Thai exports had been deteriorating even before the crisis. This is due to a lack of supporting industries which led to weak industrial linkages and high import content particularly in the heavy industries. In addition, about 90% the manufacturing sector in Thailand is SMEs[1] using obsolete technology.

To cope with the weaknesses in industrial sectors, in March 1998, the three economic ministers (Ministry of Finance, Commerce and Industry) approved the industrial restructuring plan and selected 13 targeted industries[2]. The plan had two main objectives. First, Thailand needs to increase the international competitiveness of its manufacturing sector. The domestic market shrunk during the crisis and consumers have remained careful about spending in recent years. Therefore, Thailand has

to rely more on the export market. Second, the plan aims at sustainable economic development with consideration of social, employment and environmental issues. The crisis brought back the topics of income distribution and rural development, which were neglected while the economy rapidly expanded. It becomes clear that, while, Thailand is now an industrializing country emphasizing manufacturing exports, the majority of Thai people are still engaged in the agricultural sector. Currently the agricultural sector represents slightly less than 10% of GDP, while it employs almost 40% of the labour force.

After the crisis, the government selected the food industry[3] to become one of the targeted industries, as it is believed to generate more income for people in agricultural sector. In addition, the food factories are dispersed throughout the country, a fact which supports rural development and reduces the rural-urban migration problem. Indeed, the issue of promoting the food industry is not a new idea for Thailand. The food industry was the first industry promoted in Thailand as stated in the 1st National Economic and Social Development Plan in 1961, due to its high local content. In 1980s, the industry was promoted under the name of agro-industry. During that period, this industry did not only support rural development but it also earned foreign currency for the country. However, the policy makers later decided to promote heavy industry to become Newly Industrializing Country (NICs) rather than Newly Agro-industrialized Country (NAICs) in order to take full advantages of Foreign Direct Investment (FDI). The government intensively invested in infrastructure and attracted FDI in favor of capital intensive industries. In 2000, the food industry was chosen again as one of the targeted industry by the government. It was also selected by the National Competitiveness Committee (NCC) of Thailand, to be the niche product industry for exports due to its strong export performance.

Several studies have recently investigated the true benefit of promoting food industry. In addition to strong backward linkages with agricultural sector, the food industry generates a high level of employment, particularly among unskilled labor (Bangkok Bank: 2001). Under strong export competition, the food exports have expanded continuously over decades, despite problems of shortage of raw materials. Fishery products show the highest export share among sub-sectors of the food industry. The major export items are chilled and frozen shrimp, which are mainly exported to the USA and Japan. NESDB and Sasin (2003) applied the Diamond Model proposed by Michael E. Porter and concluded that the advantages of the Thai food industry are abundant raw materials and labor. However, the industry lacks value chain management and has a loose network particularly in the supply chain, which leads to a fluctuation in prices and inconsistent quality of raw materials. The same research team examined changes in world market share of food exports from various countries during the period 1995–2000 and RCA for the year 2000. The results indicated that Thai food exports grew on average 4.7% for the previous decade, and had a high RCA of 1.95 in 2000. The food industry earned substantial foreign currency even during the economic crisis, while other manufacturing industries were heavily in debt. The industry highly benefited from the weaker baht for its exports. In addition,

with relatively low imported components, the industry was not very affected from rising imported input costs.

In spite of the widespread interest in the export performance of this industry, comprehensive studies specifically examining the role and the benefit of the food industry to the Thai economy are extremely limited. A clear quantitative analysis on the contribution of the food industry to the economy and comparison of its performance with other targeted industries are not available. A report conducted by Treerat (2003) was the only study monitoring 13 targeted industries including food industry. However, the main purpose of that analysis was to look separately at the structural change of each industry before and after the crisis. It is observed that the output value, employment, and exports of food industry significantly increased after the crisis, while value added and investment declined.

Without empirical analysis of all related data, the contribution of the food industry may be underestimated. Under this situation, it is likely this industry may be neglected or will receive relatively less support from the government as it happened in the past. Thus, the objective of this paper is to examine from various aspects the benefit of promoting the food industry. This paper goes beyond the earlier work by empirically verifying the importance of the food industry in comparison with other leading industries. Furthermore, as domestic demand is not large enough to absorb the food production, realizing the importance of the food industry is not sufficient to support the idea of promoting it. The next point of interest is to verify whether this industry has potential to compete in the international market. The paper is organized as follows: In the next section, the development of Thai food industry and its characteristics are reviewed. The linkages and benefits of the food industry in comparison with those of other industries are quantified in Section 3. Demand and supply of Thai processed food in domestic and international markets are examined in order to fully understand the structure of product distribution and potential in both markets. Export performance and international competitiveness of the food industry are examined through Revealed Comparative Advantage (RCA) and market share analysis in Section 4. Section 5 examines the export demand and supply determinants through the estimation of export demand and supply functions. Price and income elasticity are also examined. Conclusion and policy implications are presented in the last section.

2. Food Industry in Thai Economy

According to the 1st National Economic and Social Development Plan in 1961, the country policies focused on promoting agricultural sector. The food industry was the first industry that was promoted according to the Plan. In addition to the reason of using high local content, the food industry was selected because it required minimal investment and used simple technology. In the early stages, technologies available to preserve foods were limited to only drying, pickling and sugar glazing.

Corresponding with the country import substitution policy during the period of 1960s, Thailand imported technology from Japan and Taiwan to produce processed food mainly for domestic consumption. In the 1970s, the country started to generate a trade surplus from processed food exports and other labor intensive industries such as textiles, rubber and electronic parts. In 1980s, the government began to put emphasis on capital intensive industries, including steel, petrochemical and chemical industries. During this decade, Foreign Direct Investment (FDI) played a significant role in Thailand's industrialization. However, the food industry did not receive much attention from the Thai government and foreign investors. Much of the FDI in manufacturing has occurred in industries covered by the BOI[4] promotion program which provides various incentives to investors (Tambunlertchai 1993: 134). Textiles, chemicals and particularly electrical appliances were the major industries that received substantial FDI[5]. Since 1990, manufacture of food have placed greater attention on high quality products to compete in the international market. Thai food exporters also must compete with new competitors who possess abundant resources and lower labor costs such as China and Vietnam.

The Input-Output table[6] of Thailand 1990 and 2000 is used to look into the characteristics of the food industry. Thailand produces varieties of processed food for domestic consumption as well as for export. For the analysis in this paper, the processed food can be simply categorized into the following four groups:

  * Processed seafood: sea and coastal fishing and processed products such as frozen shrimp, dried and canned fish.
  * Processed fruit and vegetable:processed products such as canned fruit and fruit juice.
  * Processed meat:processed products such as frozen chicken.
  * Rice-based products: processed products such as noodle, cracker and snack.

Raw material is the most important input for processed food production as shown in Table 1. The ratio of raw material to output (R/O) of the food industry was 0.76 for the year 1990 and 2000, which was higher than the average ratio for the whole economy. The ratio of wage, operating surplus, raw material to output were calculated. The ratio of wage to output has not change over the period, the value stood at 0.07. The capital intensity[7] can be implied from the ratio of operating surplus to output (OS/O). The usage of capital to output in the food industry was lower than that of other industries.

Food industry production represented 8% of the total output in 2000. This percentage is considered high compared to 5% for electronic appliance, 2% for motor vehicle and 5% for textiles. Thailand is not only a self-reliant country in terms of processed food, the country also exports its product to international markets. The self-sufficiency rate of the food industry stood at 126% and 129% in 1990 and 2000, while the average rate for the whole economy was 80% and 93% respectively. Among food sub-sector, processed fish showed the strongest export performance.

Table 1   Characteristic of the Food Industry: Input-Output Table

Sector	1990								2000							
	W/O	OS/O	R/O	% of O	% of VA	% of EX	% of IM	% of Self	W/O	OS/O	R/O	% of O	% of VA	% of EX	% of IM	% of Self
Food (003)	**0.07**	**0.15**	**0.76**	**8**	**4**	**13**	**3**	**126**	**0.07**	**0.14**	**0.76**	**8**	**4**	**13**	**3**	**129**
Processed meat (0010)	0.11	0.23	0.62	(0)	(2)	(1)	(4)		0.10	0.18	0.68	(8)	(6)	(1)	(4)	
Rice-based product (0011)	0.10	0.20	0.65	(1)	(9)	(24)	(10)		0.10	0.15	0.72	(3)	(12)	(24)	(10)	
Processed fruit-vegetable (0012)	0.09	0.17	0.69	(8)	(4)	(3)	(6)		0.07	0.16	0.73	(8)	(7)	(3)	(6)	
Processed fish (0013)	0.06	0.14	0.76	(37)	(16)	(32)	(21)		0.06	0.12	0.81	(46)	(16)	(32)	(21)	
All sectors (001–032)	**0.15**	**0.25**	**0.52**	**100**	**100**	**100**	**100**	**80**	**0.14**	**0.21**	**0.55**	**100**	**100**	**100**	**100**	**93**

Note: See Appendix 1 for sector classification and codes
        W/O = the ratio of wage to output, OS/O = the ratio of operating surplus to output and R/O = the ratio of raw material (intermediate input) to output, O = output
        VA = value added, EX = export, IM = import and Self = self-sufficiency rate (100% self-sufficiency rate means domestic production meets domestic demand).
        The percentage in table refers to the percentage of food sector (003) to all sectors in the economy. The percentage in parenthesis refers to percentage of food sub-sector (0010, 0011, 0012 and 0013) to total food sector (003).
Source: Author's calculation based on Input-Output Tables of Thailand 1990 and 2000

The information from the 1997 industrial census and industrial survey for 2003 conducted by the National Statistical Office (NSO) are used in order to understand the current structure of the Thai food industry as shown in Table 2. A direct comparison between 2003 survey and census, as well as previous surveys is not possible due to the differences in reporting by manufacturing establishment[8]. The 2003 survey data has wider coverage and figures are larger but the information from both the census and 2003 survey confirmed that the majority of Thai manufacturing establishment consists of small enterprises. According to the 2003 survey, most establishments, particularly micro enterprises (1–9 employees) are located in the north and north-east region of Thailand.

Concerning the food industry, 73% and 16% of the total food establishments were small and medium enterprises, respectively according to the census. Similarly, data from the 2003 survey illustrated that the average number of employee per establishment was 6 persons for the food industry, which is regarded as a small industry. The food industry employed the highest number of employees in the manufacturing industry. Based on the census and survey, about 14.5% and 18% of employees in manufacturing sector worked in the manufacturing of food. Among food sub-sectors, processed fish absorbed the highest number of employees and number of person engaged.

The food industry plays an important role in the Thai economy. Based on the industrial survey and I-O tables, the production, output and value added of the food industry were relatively high compared with other industries. This industry also employed the majority of employees in

Table 2　Characteristic of the Food Industry: Industrial Survey

	All Manufacturing	Total Food	Small	Medium	Large	
Census 1997						
Value added (Baht)	998,144,453	113,562,761	-	-	-	
Value of gross output	3,541,257,252	482,334,823	-	-	-	
No. of establishment (units) and % by size of establishment	23,677	-	68%	21%	11%	
No. of establishment (units) and % by size of establishment	-	3,294	73%	16%	12%	
	All Manufacturing	Total Food	Processed Meat	Processed Fishery	Processed Fruit-vegetables	Rice-based product
No. of establishment (units)	23,677	3,294	164	430	373	386
No. of employees (persons)	2,413,325	349,034	30,316	114,035	52,023	20,132
Survey 2003						
No. of establishment (units)	359,616	97,781	3,409	3,660	2,266	9,502
No. of employees (persons)	3,381,561	598,042	74,135	158,831	63,328	53,473
No. of person engaged (persons)	3,878,251	726,716	81,221	166,623	68,184	72,847
Value of Gross Output (Baht)	6,277,497,299	675,493,790	73,355,795	177,507,494	43,716,997	32,135,342
Value added (Baht)	1,399,412,108	144,245,984	20,862,558	39,649,441	9,919,386	9,758,371

Note:　NSO applies International Standard Industrial Classification of Economic Activities (ISIC) for sector classification
　　　　Industrial codes according to NSO are; food (1511–1549), processed meat (1511), processed fishery (1512), processed fruit and vegetables (1513), rice-based product (1541, 1544)
Source: NSO Industrial Census 1997 and Industrial Survey 2003

manufacturing sector. Among food sub-sectors, processed fish shows the highest percentage of gross output, value added as well as employment. Thailand not only produces processed food to supply domestic demand but the country is also capable of exporting to international markets. However, capital intensity and FDI for the food industry are relatively low. This situation could affect the development and production capacity of this industry in the future. In order quantify specifically the contribution of the food industry to the economy in terms of employment, production linkages and net foreign exchange earning, an inducement analysis will be performed in the next section.

3. Direct and Indirect Impacts of the Food Industry on Thai Economy

3.1 Input-Output Model and Data

　　The analysis applied both the competitive import type and non-competitive import type input-output tables of Thailand 2000 provided by the National Economic and Social Development Board

(NESDB). The non-competitive import type is used in order to clearly distinguish between domestic and imported products. Firstly, the industrial linkages will be calculated in order to identify the leading industries in the country. Each element in Leontief inverse matrix $(I-A)^{-1}$ where A is the matrix of input coefficient, reveals the linkage between industries in the economy[9]. The formulae (1) and (2) proposed by Rasmussen (1956: 133-4) presents "index of power of dispersion (U_j)" and "index of degree of sensitivity(U_i)", which can be regarded as measures of backward and forward linkages as seen by Hirschman (1958: 98). By defining $Z= (I-A)^{-1}$, $\sum_{i=1}^{n} Zij = Z.j$ and $\sum_{j=1}^{m} Zij = Zi.$ indicate the column sum and row sum respectively, where m refers to number of sectors. A value of index which is greater than unity implies an above average linkage, and the sector can be classified as a leading sector or key sector. The same indices are calculated again using $Z=(I-A^d)^{-1}$ where A^d is the matrix of input coefficient of domestic transaction which takes into account of the leakage due to imports of raw material.

$$U.j = \frac{[(1/m)Z.j]}{[(1/m^2)\sum_j Z.j]} \tag{1}$$

$$Ui. = \frac{[(1/m)Zi.]}{[(1/m^2)\sum_i Zi.]} \tag{2}$$

Secondly, the analysis will focus on the leading industries by applying the non-competitive import type I-O models given by:

$$X = A^d X + F_k^d \tag{3}$$

$$M = A^m X + F_k^m \tag{4}$$

where X is matrix of gross output, A^m is the matrix of input coefficient of imported goods, F_k^d is vector of final demand on domestic goods (k refers to vector of private consumption, government consumption, investment and exports) and M is a matrix of imports. The induced output and import by domestic final demand are given in equations (5) and (6). Induced value added and employment are given in equations (7) and (8), where l denotes employment coefficient row vector and v represents value added coefficient row vector. The inducement analysis in this section examines the impact from the final demand of a particular sector on the whole economy. The final demand of one sector not only induces production, import, employment and value added in its own sector but also in related sectors.

$$X = (I-A^d)^{-1} F_{ik}^d \tag{5}$$

$$M = A^m (I-A^d)^{-1} F_{ik}^d \tag{6}$$

$$V = v (I-A^d)^{-1} F_{ik}^d \tag{7}$$

$$L = l (I-A^d)^{-1} F_{ik}^d \tag{8}$$

3.2 Inducement Analysis

Analyses using Rasmussen's indices were performed as shown in Table 3. The selected manufacturing sectors in the first column can be labeled as leading sectors on the basis of the Leontief inverse matrix $(I-A)^{-1}$. These sectors highly induce production in downstream or upstream industries. The backward and forward linkage indices of the food industry became noticeable higher after the matrix of input coefficient of domestic transactions (A^d) is used in the calculation. In contrast, the indices of electronic appliances, motor vehicles and office equipment became less than unity after using domestic input coefficients for calculating backward and forward linkages. The $(I-A^d)^{-1}$ indicates the present linkage which takes into account of leakage. Sector with high import content are likely to show lower indices, while the agricultural sector and food industry, which are less import-dependent, show higher indices after employed the concept of net linkage. Within the food sub-sector, processed meat shows the highest backward linkage after the leakage was considered.

However, by observing these indices, explanation for the linkages in value term cannot be revealed. In addition, the sectors that these leading industries impact on also cannot be identified. As a result, inducement analysis will be performed focusing on the leading industries to provide linkages details.

Table 3　Index of Power of Dispersion and Index of Degree of Sensitivity

Sector	Indices from $(I-A)^{-1}$		Indices from $(I-A^d)^{-1}$	
	Power of Dispersion	Degree of Sensitivity	Power of Dispersion	Degree of Sensitivity
Agriculture (001)	0.7296	1.3590	0.9294	1.5387
Food (003)	1.0117	0.8770	1.2583	1.0828
Processed meat (0010)	1.1237	0.4161	1.4567	0.5963
Rice-based product (0011)	1.0963	0.5049	1.2047	0.6634
Processed fruit and vegetable (0012)	0.9727	0.4240	1.1179	0.6636
Processed fish (0013)	1.1318	0.5142	1.2504	0.6516
Textile (006)	1.0091	1.0621	1.1177	1.2718
Wearing apparels (007)	1.0667	0.4499	1.2463	0.6768
Office Equipment (018)	1.2993	0.8028	0.9179	0.7405
Electronic appliance (019)	1.9889	1.8050	0.7240	0.6747
Motor vehicle (022)	1.3575	0.8697	0.8149	0.7667

Note:　See Appendix 1 for sector classification and codes
Source: Author's calculation based on Input-Output table 2000

Table 4 presents the summary of all inducement analysis based on I-O table 2000. The total final demand (Row No. 7) of the food industry was the highest due to its strong domestic demand and export. Although export of electronic appliances and office equipment ranked first and second, followed by food industry exports, their domestic final demand was much lower than that of the food

Table 4　Summary Results of Inducement Analysis* (unit: Billion Baht or as stated)

	Agriculture (001)	Food Industry (003)	Textiles (006)	Wearing Apparel (007)	Office Equip. (018)	Electronic Appliances (019)	Motor Vehicle (022)
(1) Production inducement by domestic final demand	175.9	534.1	29.8	392.2	28.7	24.6	143.2
(2) Production inducement by export	38.0	744.3	222.0	179.5	693.4	533.2	123.3
(3) Total production inducement	213.9	1,278.4	251.7	571.7	722.1	557.8	266.5
(4) Import inducement by domestic final demand	15.1	51.4	5.1	51.4	9.9	16.6	71.8
(5) Import inducement by export	3.3	71.6	38.4	23.5	240.4	374.4	61.9
(6) Total import inducement	18.4	123.0	43.5	74.9	250.4	391.0	133.7
(7) Total final demand*	140.6	621.0	137.7	280.4	474.7	487.8	199.9
(7.1) Domestic final demand	115.7	259.4	16.3	192.3	19.1	20.8	107.4
(7.2) Export	25.0	361.6	121.4	88.0	461.7	467.0	92.5
(8) Production inducement coefficient	1.52	2.06	1.83	2.04	1.52	1.14	1.33
(9) Net Foreign Exchange	6.6	238.5	77.9	13.1	211.3	76.0	-41.2
(10) Total Employment Inducement (persons)	1,727,243	3,908,133	165,562	338,286	265,398	223,941	147,471
(11) Number of Employees** (persons)	13,890,000	327,421	232,536	144,450	60,686	153,417	101,617
(12) Total Value Added Inducement	122.2	497.6	94.1	205.4	233.4	96.8	66.2
(13) Value Added*	463.2	211.4	127.8	95.2	120.9	60.6	46.6
Detailed Analysis for Food Industry							
	Processed Meat (0010)		Rice-based product (0011)		Processed fruit and Vegetable (0012)		Processed Fish (0013)
(1) Production inducement by domestic final demand	17.0		106.9		18.8		7.4
(2) Production inducement by export	74.3		18.4		53.7		351.4
(3) Total production inducement	91.3		125.3		72.5		358.8
(4) Import inducement by domestic final demand	0.8		13.3		1.9		0.8
(5) Import inducement by export	3.4		2.3		5.4		3.4
(6) Total import inducement	4.1		15.6		7.3		42.9
(7) Total final demand*	37.2		61.8		38.5		170.4
(8) Production inducement coefficient	2.45		2.03		1.88		2.11

Note:　Total production inducement equals to production inducement by domestic final demand and by export {(3) = (1) + (2)}
Total import inducement equals to import inducement by domestic final demand and by export {(6) = (4) + (5)}
Total final demand refers to total domestic final demand (private consumption, government consumption and investment) and export
Production inducement coefficient is the ratio calculated by total production inducement divided by total final demand {(8) = (3) / (7)}
Net foreign exchange refers to export minus total import inducement (10) = (7.2) － (6)
See Appendix 1 for sector classification and codes
Source:　* Data from Input-Output Table 2000, while the remaining numbers are from author's calculation based on the same Input-Output Table
** Industrial Survey 2001 (data of year 2000), National Statistical Office and the Bank of Thailand

industry.

The production inducement represents the extent of output to be produced at a given final demand; in this case it is a final demand for the year 2000. The food industry showed the highest total production inducement (Row No. 3) of 1,278.4 billion Baht. The production inducement by domestic final demand was 534.1 billion Baht, while the inducement by exports was 744.3 billion Baht. The production inducement coefficient (Row No. 8) was also highest in the food industry with the value of 2.06. Among sub-sectors of the food industry, processed meat provided the highest production inducement coefficient, while processed fish showed the highest production inducement value.

A high production inducement was caused by a combination of high final demand (either domestic demand or export) and strong production linkages. For the food industry, the total final demand was the highest among leading industries, resulting in a large size effect on production inducement. Despite a strong size effect, the food industry shows the highest unit effect on the whole economy. A unit increase of final demand for food sector induces 2.06 unit of production for related sectors including its own sector[10]. The highest value came from a strong backward linkage with agricultural sector.

Strong linkages and high final demand do not guarantee that all benefits would be kept within the country. There could be a leakage if the production of particular sector requires high import material. This situation is likely for value of import inducement by exports (Row No. 5) of electronic appliance and office equipment. Electronic appliance induced 374.4 billion Baht of import, which represented about 80% of its export value. Its export induced large amounts of input from abroad, and it has led to a big loss in foreign currencies. On the contrary, a relatively low import content and high export value of the food industry has led to the highest net foreign exchange earning (Row No. 9) of 238.5 billion Baht.

The employment coefficient is calculated using the 2001 industrial survey conducted by the National Statistical Office of Thailand and the online employment data from the Bank of Thailand[11]. As mentioned earlier, agricultural sector absorbs the majority of the Thai labor force. However, among various leading industries, the food industry shows the largest level of employment (Row No. 11) and employment inducement (Row No. 10). The induced employment of the food industry was remarkably high, as 88% came from employment in agricultural sector. Furthermore, the value added inducement (Row No. 12) of food industry was the highest among leading sectors. About 40% of induced value added of the food industry came from agricultural sector.

Compared with other industries, the production inducement by domestic final demand and by food industry export showed the highest impact on the whole economy in term of size and per unit effects. This sector also generated the highest net foreign exchange due to its high export and low induced import. Furthermore, the food industry not only absorbed the majority of those employed but also generated the largest number of employment inducement. Export has often been the prime if not

the sole reason for policy prioritization even if the majority do not benefit from export. The analysis in this section clearly illustrates and compares the contributions of leading industries in terms of production linkages, employment and imports. The results indicate that among leading sectors, the food industry provides remarkable benefits to the economy.

3.3 Linkage Analysis of the Food Industry

Using information from Input-Output tables of year 1990 and 2000, the input requirement and product distribution of 4 food categories are illustrated through linkages figures. From the figure, major inputs for production and sources of demand are shown in percentage terms.

3.3.1 Processed Meat (I-O code 0010)

Processed meat refers to canned and preserved (chilled, frozen, dried, etc.) of pork, chicken and buffalo meats. Unfortunately, the I-O table combines manufactured types of meat and therefore, it can not be further disaggregated in detail. Figure 1 shows that livestock and poultry are two major inputs for processed meat. In 2000, about 33% and 49% of total intermediate input of slaughtering were a result of livestock and poultry. Thailand can produce sufficient livestock and poultry to supply raw material for the production of processed product. Only 1–2% of raw materials are imported. These import inputs are chemical products, rubber and plastic. About one half of meat product after slaughtering was consumed domestically, while the other half was used as input to produce processed meat for export. According to Figure 1, the export of canned and preserved meat dramatically

Figure 1   Processed Meat
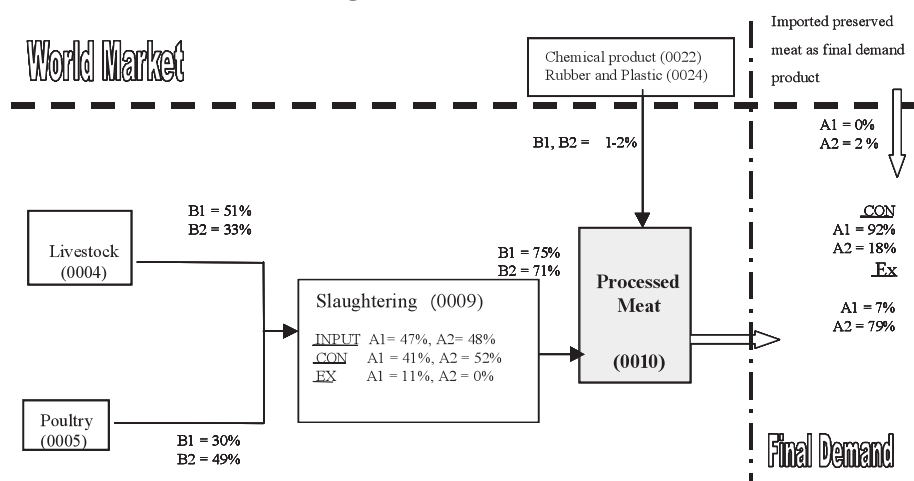
Note: See Appendix 1 for sector classification and codes
      The black-thick arrow presents the direction of product distribution from selling sector to purchasing sector as intermediate input, while the white-thick arrow shows the distribution of output to private household and foreign market as final demand products.
      Alphabet A refers to share of output of selling sector in the total domestic output of the referred product, while alphabet B refers to share of selling sector product in the total intermediate input of the purchasing sector.

increased from 7% of total domestic production in year 1990 to 79% in year 2000.

Thai people prefer cooking raw meat to consuming canned and preserved ones. Processed products are mainly exported to international markets. This sector has good prospects as most of the input can be domestically produced. In addition, its export output has significantly increased, while import of final demand remains low.

3.3.2 Rice-based Product (I-O code 0011)

Rice-based products refer to bakery, dairy products, flour and noodles. Figure 2 shows that domestic private consumption remains the major source of demand. Among 4 categories of processed food, the production of rice-based product is the only one that does not rely on exports. Similar to other processed food, import of raw material for production was low.

Figure 2　Rice-based Product
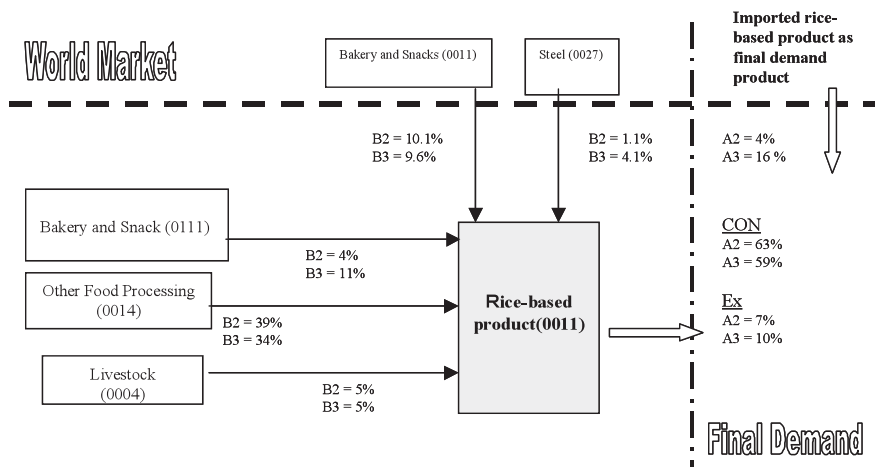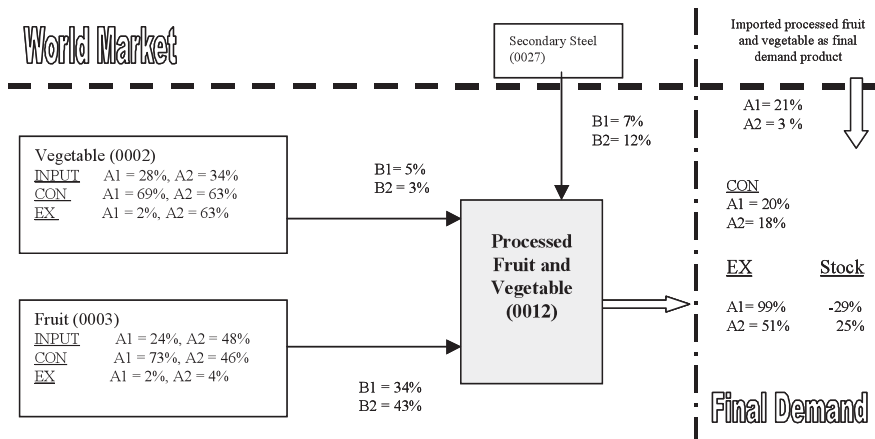

Note: Same as Figure 1
Source: Same as Figure 1

3.3.3 Processed Fruit and Vegetables (I-O code 0012)

Fresh fruit and vegetables are normally consumed in the country, while processed ones were export to international markets as shown in Figure 3. Preserved products include sugar glazing, fruit and vegetable juice and pickles. In year 2000, 46% and 63% of total domestic output of fruit and vegetables respectively, were consumed by domestic household, while most of the remaining were used as raw material for canned and preserved products. Fruit and vegetables have a very short product life cycle. By preserving them, the product can be stocked for future demand. Among 4 types of food categories, the stock of processed fruit and vegetables played an important role. As a result, the percentage of stock in final demand is shown in Figure 3. Similar to processed meat, processed fruit and vegetable products were mainly distributed to international markets. Import as final demand represents only 3% of total domestic output in the year 2000. Most imported products are winter

products such as pear and kiwi, which the country does not produced.

## Figure 3   Processed Fruit and Vegetables

Note: Same as Figure 1
Source: Same as Figure 1

3.3.4 Processed Fish (I-O code 0013)

Processed fish refers to chilled, frozen and dried fishery products. The usage of fishery as raw materials has increased over the decades as shown in Figure 4. To produce this item, most raw material can be acquired domestically. Thai people consume more chicken and pork than fish products. In year 2000, 21% of fishery product was consumed by private households, while 78% was used as intermediate input for producing preserved one. The production of processed fish targeted international markets. Only 2% of production was consumed domestically in 2000.

Figure 4   Processed Fish
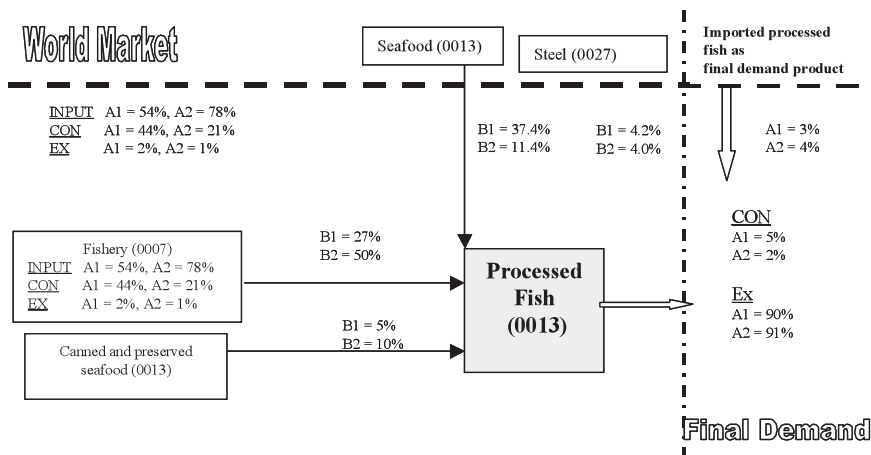
Note: Same as Figure 1
Source: Same as Figure 1

According to all data, consumption and export patterns have changed over the past decade. Exports have become an important source of demand. Thailand is a net food exporter. Fresh products are mostly consumed domestically, while processed ones are exported to international markets. A high local content is an advantage of this industry. Domestic demand is not large enough to absorb all production. According to the Ministry of Agricultural and Cooperatives in year 2005, about 20% of pineapple products were consumed domestically, while the rest were exported mostly in the form of canned pineapple. A similar trend can be observed from fishery, where about 16% of goods were consumed domestically, while the remaining was exported in the form of processed goods. Unlike these two products, approximately one half or more of chicken production were consumed within the country.

4. Current International Competitiveness of Thai Food Export

4.1 Current Export Performance

Each year Thailand earns about $6–7 billion from the export of processed food and about $8–10 billion from agricultural products including rice. Thailand now ranks among the top ten exporters of many food commodities such as rice, canned pineapple, and processed fish, especially tuna and frozen shrimp. Various Thai food products are exported to international markets. Exports of processed fish represented about $4 billion each year. About half of fishery products are chilled, frozen, boiled and dried products, while the other half is canned and processed ones.The main export items are frozen and processed shrimp with a total export value of US$1,754 million in 2005. For fruit and vegetables, slightly less than 50% of products are canned and processed goods, while the remaining are juice and frozen ones. Thailand exports a variety of tropical fruits. Canned pineapple is one of the major export products. Regarding meat products, frozen and processed chicken represent about 90% of total export of meats. The export value of frozen chicken dramatically dropped in the years 2004 and 2005 due to the Avian Influenza outbreak.

Thai food exports range from primary agricultural commodities to processed foods. In order to see the international competitiveness of Thai food exports, its RCA and market share are examined in the next section.

4.2 International Competitiveness of Thai food: Revealed Comparative Advantage (RCA)

Thailand holds about 2–2.5% of world food export share in 2000–2003 according to the Information Center of the National Statistical Office of Thailand. In the year 2003, the country ranked 15th among the world food exporters. In Asia, Thailand ranked only behind China (ranked 10th) in terms of food exports. Due to its strong export performance, the Thai government and the NCC recently decided to promote the country as "Kitchen of the World." It set the target for Thailand to join the

world top five food exporters by year 2007.

In order to identify the comparative advantage of Thai food in the world market, RCA[12] was calculated based on the United Nations COMTRADE statistical database. By utilizing SITC (Rev 3), RCA for food and live animals was calculated for ASEAN countries and China as shown in Table 5. The share of food exports to total exports of Thailand and Vietnam are higher than other ASEAN countries. In year 2002, Vietnam's food exports accounted for about US$ 4 billion, while food exports of China and Thailand in year 2003 accounted for US$ 14 billion and US$ 10 billion respectively.

The Thai manufacturing sector has progressed to producing more complicated products, and therefore, the percentage share of food exports has declined, which led to a decline in RCA indices. Still, the index remains greater than unity, showing the country competitiveness.

Table 5   Revealed Comparative Advantage

Country	Year	Share (%)	Food* RCA	Meat ** RCA	Fish*** RCA	Fruit and Vegetables**** RCA
China	1990	11	1.45	-	-	-
	1997	6	0.90	0.82	1.82	1.29
	2003	4	0.79	0.57	2	1.27
Viet Nam	1997	29	4.34	0.43	9.51	2.04
	2002	25	3.7	0.23	14.93	2.35
Thailand	1990	28	3.77	1.42	11.41	5.0
	1997	18	2.68	1.07	8.25	1.91
	2003	14	2.40	1.90	6.06	1.53
Indonesia	1990	9	1.20			
	1997	7	0.99			
	2003	6	1.11			
Malaysia	1990	4	0.58			
	1997	2	0.56			
	2003	2	0.37			
Philippine	1990	13	1.76			
	1997	5	0.79			
	2003	4	0.69			

Note: (-) data not available, share refers to share of food export to total exports
        * SITC (Rev 3) code 0 － Food and live animals, ** SITC (Rev 3) code 01 － Meat and meat preparations
        *** SITC (Rev 3) code 03 － Fish, crustaceans, mollusc, **** SITC (Rev 3) code 05 － Fruit and vegetable
Source: UN COMTRADE

The food industry encompasses a variety of products. The RCA of 3 food categories (meat, fish

and fruit and vegetables) was calculated for Thailand, China and Vietnam. Thailand has export specialization in meat products. The RCA for meat is higher than that of China and Vietnam. Thai RCA of 3 food categories are all greater than unity, particularly fish products, which indicate the country's export competitiveness in the world market. The export value of this product is also the largest among other Thai food export categories. However, the RCA indices of Thai food industry have declined. In addition, RCAs of neighbouring countries are on an increasing trend. For instance, Vietnam's RCA of fish product was remarkably high with 2-digit values in year 2002. Although the export value of Vietnam was behind Thailand and China, it has increased significantly. Vietnam has become a major competitor in the world market. However, for food exports, the competition is not limited only to ASEAN and China. Market share in major importing countries will be examined in the next section to clearly understand Thai export performance and its competition.

4.3 Market Share in Major Foreign Markets

Currently Thailand has become the world leader of food exporters for many commodities. Thailand has comparative advantage in export of fish, meat, fruit and vegetable products. Frozen shrimp, canned pineapple and frozen chicken are the major export items under each aforementioned category. The export performances of these products in major importing countries are further reviewed in this section.

4.3.1 Poultry Export

The export of processed chicken accounted for 90% of total Thai meat exports. Under COMTRADE database, specific trade information on chicken alone is not available, and therefore poultry data is described. Thai exports of poultry are not yet recognized in the world market. United States, Brazil, Netherlands and France are the major world exporters of this product. Each year, about 50% of Thai poultry was imported by Japan, followed by European countries such as Germany. The share in Japanese market was on an increasing trend as shown in Table 6. Thailand ranked first in the Japanese market in 2002 and 2003. Unfortunately, due to the out break of Bird Flu in 2004, Japanese demand for poultry declined and the imports of Thai poultry dropped from 41% in 2003 to 4% in 2004. Thai and Chinese poultry were replaced by products of other countries, particularly Brazil. There has been an increased demand for health and food safety. As a result, products form France, which did not have access to the Japanese market in the past, could be recently exported to Japan although their prices were higher than other competitors. Only a few large scale producers in Thailand have continued exporting by mean of an appropriate system of raising and producing poultry products.

4.3.2 Prepared and Preserved Pineapple

Thailand can export many types of tropical fruit and vegetable products, but Thai exports of prepared and preserved pineapple, particularly canned pineapple are most notably recognized in the world market. The export share of Thai prepared and preserved pineapple has ranked first in the

Table 6   Japanese imports of Meat and Edible Offal
of the Poultry of Heading

Japan	2002	2003	2004
Total (US$)	959,055,502	814,981,484	749,177,373
Brazil	29%	32%	80%
USA	7%	7%	6%
France	-	-	3%
Thailand	38%	41%	3%
China	20%	12%	-

Note: (-) refers to % less than top four
Source: SITC (Rev 3) code 0123, COMTRADE

world market for more than a decade. Thailand has occupied, for instance, 48.4%, 38.7% and 44.3% of world market share in 1993, 1997 and 2003 respectively. The major importers of Thai pineapple are Japan, Germany and USA. In the Japanese market, Thailand presents strong export performance over neighbouring countries as shown in Table 7. In the US market, exports are gaining strength, ranking behind only those of the Philippines.

Table 7   Imports of Prepared and Preserved
Pineapple

Japan	2002	2003	2004
Total (US$)	39,945,074	39,016,966	42,795,043
Thailand	55%	52%	53%
Philippines	19%	21%	20%
Indonesia	18%	16%	18%
USA	2002	2003	2004
Total (US$)	224,530,642	255,517,512	263,061,160
Philippines	45%	41%	39%
Thailand	28%	32%	36%
Indonesia	17%	15%	15%

Source: SITC (Rev 3) code 05893, COMTRADE

4.3.3 Frozen Shrimp and Prawn

Exports of processed shrimp brought in the highest foreign currency among all Thai food exports. Thailand ranked first in the world market share in 2000 and 2001 for the export of frozen shrimp and prawn with the shares of 17.2% and 15% respectively. In 2003, Vietnam became the leader among

world exporters of frozen shrimp and prawn, accounting for 11.5% followed by Thailand 10.5%. USA and Japan are the main world importers and the major importers of Thai frozen shrimp and prawn. Thailand has the highest market share in USA, and ranked forth or fifth in the Japanese market as show in Table 8.

Table 8   Imports of Frozen Shrimp and Prawn

Japan	2002	2003	2004
Total (US$)	2,156,192,338	1,949,886,266	2,007,366,837
Indonesia	24%	25%	21%
India	14%	11%	11%
Viet Nam	15%	20%	23%
Thailand	9%	8%	7%
China	6%	7%	8%
USA	**2002**	**2003**	**2004**
Total (US$)	2,716,663,971	3,078,260,011	2,952,599,319
Thailand	19%	19%	16%
Mexico	10%	10%	11%
India	13%	13%	12%
Viet Nam	14%	16%	9%
China	8%	11%	-
Indonesia	-	-	11%

Note: (-) refers to % less than top five
Source: SITC (Rev 3) code 03611, COMTRADE

Thailand has a comparative advantage in exporting food. Its export performance is recognized in the markets of major trade partners. In order to understand the determinants of Thai export of these commodities, export demand and supply equations are estimated in the next section.

5. Export Potential of Thai's Processed Food

5.1 Export Demand and Supply of Thai Processed Food

There have been enormous amount of research estimating the export supply and demand equations. Athukorala and Suphachalasai (2004) examined post crisis export performance of the Thai manufacturing sector using a reduced form export equation. Their analysis concluded that in addition to significant results for price and income elasticity, real exchange rate depreciation is a significant determinant of post crisis export recovery. In spite of the widespread interest in the determinants of

export, relatively little empirical evidence has been found on Thai food industry.

As mentioned in Section 3, the food industry provides a strong contribution to the Thai economy through it production linkages, employment inducement and foreign exchange generation. The government currently supports export of processed food in order to increase value added of agricultural product and to bring in more foreign currency to the country. The export performance and international competitiveness of Thai food, particularly processed food, were reviewed in the previous section. The last issue to justify the support for food industry is to examine the factors that determine Thai export demand and supply of frozen chicken, canned pineapple and frozen shrimp.

To estimate the determinants of export demand and supply, the equations are specified in the following form respectively:

$$\text{Log}(E_t) = \alpha_1 + \beta_1 \text{Log}(RP_t) + \beta_2 \text{Log}(AGDP)_t + \varepsilon_t \tag{9}$$
$$\text{Log}(E_t) = \alpha_2 + \beta_4 \text{Log}(PRICE_t) + \beta_5 \text{Log}(E_{t-1}) + \varepsilon_t \tag{10}$$

For export demand, variables are export quantity (E_t), unit price of Thai export in US$ relative to world price of concerned products (RP) and accumulated GDP of major trade partners (AGDP). The AGDP reflects income of major importers, while RP reflects the price comparison between Thai export price and world price, which importers monitor. The coefficient β_1 and β_2 represent price and income elasticity as the equations were estimated in natural logarithm form. Thai export supply capacity model incorporates export quantity of the previous period (E_{t-1}) and relative price (PRICE) in US$, which is a ratio of export price against domestic price (proxy by CPI adjusted with exchange rate). The export quantity of previous period is a proxy for the production capacity, while (PRICE) is included based on the assumption that domestic and export prices influence producer decision whether to sell domestically or to export.

5.2 Estimation Results and Implications

Ordinarily Least Square (OLS) method was applied for export demand and supply equations. The Augmented Dickey-Fuller (ADF) tests were conducted to examined the stationary of individual time series. Since all variable are not I(0), the cointegration technique was conducted to investigate long-run relationship. The results indicated that non-stationary series are cointegrated, as a result the OLS method is valid. Cochrame Orcutt method was performed, when there was an auto-correlation. The data is available for the period of 1980–2002, and trade data was taken from United Nation's COMTRADE database and Food and Agriculture Organization (FAO). GDP and CPI are from the World Bank, while exchange rate data was acquired from the Bank of Thailand.

5.2.1 Demand Equations

Table 9 shows the estimation results of demand equations. For all three export commodities, exports significantly respond to the changes in relative prices. The estimated coefficients for RP in

the case of canned pineapple and frozen chicken were significant and greater than unity, reflecting the elastic demand. This indicating that the emergence of competitors such as China and Vietnam, will cause the keen price competition between their products and Thai export.

The estimated coefficients on importers' income were positive and significant for frozen chicken and canned pineapple. However, the income elasticity was negative and not significant for the case of frozen shrimp. One possible reason is that increases in income of importers create more concern on health issue and food safety. For instance, EU announced zero tolerance policy in 2001, on antibiotic in shrimp shipment from East Asia. The antibiotic issue has affected many shrimp exporters, particularly China, Vietnam and Thailand. Japan and the US also increasingly monitor chemical contamination in their shrimp imports. Another reason lies on the fact that importers' consumption patterns have changed. There is an increasing trend particularly in the Japanese import of prepared and preserved shrimp. According to online trade statistics database of the United Nation (COMTRADE), Japanese import of prepared and preserved shrimp from Thailand equivalent to one-fourth of frozen shrimp import in 1995. However, it has surpassed the import of frozen shrimp since 2001. With regard to relative price, it is less elastic than frozen shrimp and canned pineapple.

Table 9   Estimation Results of Export Demand Equation

Explanatory Variables	Frozen Chicken	Canned Pineapple	Frozen Shrimp
Intercept (t-statistic)	-32.17*** (-11.62)	-2.11 (-0.27)	31.51 (1.05)
Log(RP) (t-statistic)	-1.89*** (-3.67)	-2.22** (-2.55)	-0.92*** (-5.46)
Log(AGDP) (t-statistic)	4.95*** (15.47)	1.54* (1.88)	-2.03 (-0.66)
Adjusted R-squared	0.96	0.82	0.95
Durbin-Watson	1.69	1.92	2.22

Note: Dependent variable is log of export quantity
         Significance level at 1%, 5% and 10% are indicated by ***, ** and * respectively
Source: Author's calculation

5.2.2 Supply Equations

The export supply significantly depends on export supply of the previous year as shown in Table 10. Regarding relative prices between export price and domestic price, the coefficients are insignificant for all three products. This is possibly due to the nature of product as shown in Figure 1, 3 and 4 that the Thais has preference for consuming fresh food rather than preserved ones. There is a production differentiation in both domestic and export markets. From the producer's point of view, most food enterprises are SMEs, producing for domestic demand, while the large enterprises concentrate on exporting. As a result, for the exporter, domestic prices may not influence their

business decisions.

Table 10   Estimation Results of Export Supply Equation

Explanatory Variables	Frozen Chicken	Canned Pineapple	Frozen Shrimp
Intercept (t-statistic)	-0.42 (-0.17)	2.93 (1.01)	2.22 (1.37)
Log(PRICE) (t-statistic)	0.31 (0.64)	-0.10 (-0.25)	-0.28 (-0.78)
Log(Et-1) (t-statistic)	0.93*** (16.57)	0.80*** (5.50)	0.95*** (12.44)
Adjusted R-squared	0.94	0.76	0.92
Durbin-Watson	1.86	2.09	2.11

Note: Dependent variable is log of export quantity
　　　　Significance level at 1%, 5% and 10% are indicated by ***, ** and * respectively
Source: Author's calculation

6. Conclusions and Policy Implication

For the food industry to receive continuous support, the clear contribution of this industry to the economy must be clearly illustrated. According to the I-O inducement analysis, it can be concluded that among the various Thai leading industries, the food industry gave the strongest contribution to the economy in terms of production linkages, employment generation and foreign exchange earning. The production inducement of the food industry is the highest and import inducement is relatively low, which allowed the industry to generate the highest net foreign exchange. Furthermore, the food industry absorbs the majority of employees in the manufacturing sector, while at the same time it highly induced employment in the agricultural sector and food related sectors. The inducement effect of this industry was high both in term of size and unit effect.

Comparing with all leading industries, the analysis confirmed that promoting food industry exports will not only directly benefit the food industry itself but also will substantially benefit the economy, particularly for agricultural sectors, which involve the majority of Thai people. Since import content is low, related industries in the country will also fully benefit from a stronger demand in this sector. Although, electronics appliances, motor vehicles and office equipments can be considered good candidates for leading industries, the development of upstream industries and supporting industries are required to fully utilize potential linkage. Therefore, in terms of realizable impacts, the food industry has larger backward linkage at the present time.

Due to a small domestic market, the export market became vital. Revealed Comparative Advantage, market share and export demand and supply equations of the three major processed foods were examined. The results confirmed that Thai processed food performed well in the international

market, but export competition is getting keen and Thai export competitiveness has been declining. Exports of some Thai processed food are highly price elastic. The emergence of competitors such as Vietnam and China with lower labour costs has become a threat to the Thai food industry. The food industry needs to improve its productivity to reduce costs of production to compete with the new emerging competitors.

Furthermore, most enterprises in the food industry are SMEs. They have various limitations in their ability to enter and compete in the international market. This empirical study suggests that continuous supports and collaboration among small producers, academic institutes and the government could help ease the weakness and enhance international competitiveness. Recently, there has been a high concern over health issues, therefore, support and collaboration on food safety and improvement of products quality can help to expand Thai market share and reduce the case of product rejection. Nevertheless, the industry is in need of investment and better technology for production. Policies to attract FDI and stimulate investment will not only help to produce quality products but also will reduce cost of production. Finally, the exports of primary products still exceed processed ones for many food products. Increasing exports of processed items could help to generate more value added, create better income distribution for farmers, and induce production and employment in related industries.

Notes

1   According to the regulation of the Ministry of Industry issued on September 11, 2002, the definition of SME based on size (using the number of employment) or the value of the total fixed assets (not include land), consider the one that is lower. Business activities are classified into 4 categories which are; manufacturing sector, wholesale sector, retail sector and services sector. In the manufacturing sector, small enterprises refer to enterprises where the number of employment does not exceed 50 persons or fixed assets do not exceed 50 million Baht. Enterprises with employment of 51−200 persons or fixed asset exceeding 50 million Baht but not surpass 200 million Baht are considered medium enterprises. Most studies focus on employment definition since SMEs provides strong contributions to domestic economy in terms of number of employment. In addition, employment definition seems to be the most applicable choice to incorporate with the data from the National Statistical Office into the study.

2   Based on the Industrial Restructuring Plan, which was proposed after the crisis by the Ministry of Industry, the targeted industries are: (1) Food and animal food (2) Textile and garment (3) Footwear and leather product (4) Wood and wooden furniture (5) Medicine and chemical product (6) Rubber and article thereof (7) Plastic and article thereof (8) Ceramic and glass (9) Electrical appliance and electronics (10) Vehicle and parts (11) Gem and Jewelry (12) Iron and steel (13) Petrochemical.

3   In this paper, food product refers to agricultural products (from agricultural sector) and processed product (from food industry) for human consumption. According to FAO definition, the food industry belongs to the manufacturing sector also known as agro-industries, agricultural processing or agro-processing industries. These characteristically receive raw and intermediate agricultural sector materials, process them, and produce food for human consumption, or semi-processed materials which will in turn serve as raw materials for other processes.

4   The Board of Investment (BOI) is one of many organizations under the Prime Minister Office, responsible for supporting foreign investors investing and doing business in Thailand. BOI provides incentives such as tax

reductions on machinery import and corporate income exceptions.

5　According to the Bank of Thailand, in 1980, FDI for the food industry accounted for 2.36% of the total net flow of FDI of 189 million US Dollars, while electrical appliances represented 11.59%. In 1990, from the total net FDI of $2,542 million, the percentage of FDI for the food industry stood at 2.48%, while the electrical appliances accounted for 16.50%.

6　The National Economic and Social Development Board of Thailand released I-O tables every 5 years. For empirical analysis, the competitive import type input-output table of year 1990 and the latest from 2000 are used in order to review the characteristics of the food industry over the past several decades. Originally, Thai economy was divided into 180 sectors, however, for the purpose of analysis of the food industry, sectors are aggregated into 32 sectors for general analysis and 43 sectors for detailed analysis of the food industry. The commodity classification of input-output table is explained in Appendix 1.

7　The operating surplus refers to value added less wage, depreciation and indirect tax. Thus, the rest is expenses on capital and machinery. The capital intensity for the production can be indirectly seen from the ratio of operating surplus to value of output (OS/O).

8　The Industrial Census 1997 and Survey of 2003, which contain information for the year 1996 and 2002, are the latest census and survey available in Thailand. The coverage industry reporting in the Industrial Survey 2003 was different from the census and pervious surveys. This is the first survey that includes establishments employing fewer than 10 people, while previous survey included only those with at least 10 persons.

9　The vertical sum of Leontief inverse matrix or total requirement matrix reveals the total (direct and indirect) output requirement for a unit increase in the final demand for the output of sector j. The horizontal sum indicates the increase in output of sector i needed to sustain a unit of final demand of all the sectors. A backward linkage measures the relationship between the activity in a sector and its purchases from other sectors, while a forward linkage indicates the relationship between the activity in a sector and its sales to other sectors.

10　A unit increase of final demand of textiles, wearing apparel, office equipment, electronic appliances and motor vehicles are 1.83, 2.04, 1.50, 1.18 and 1.33 respectively.

11　The industrial survey of 2001 covers the data for the year 2000, which corresponds with the data in I-O 2000. Data on employment in agricultural sector and some sectors such as public utilities, transportation and services are not available in the industrial survey. In lieu of this gap, data from the Bank of Thailand for the same year is used.

12　The RCA index was first introduced by Bela Balassa in 1965 to analyze trade specialization. $\text{RCA}_{ij} = \dfrac{Xij/\sum_{i} Xij}{\sum_{j} Xij/\sum_{i}\sum_{j} Xij}$ where Xij are exports of industry i from country j. The numerator represents percentage share of a given industry in national exports, and the denominator represents the percentage share of a given sector in the world. The RCA index shows the degree of export specialization in comparison with the world regarding specific commodities. When RCA is above 1 the country is said to have comparative advantage in that sector, and vice versa where RCA is below 1. RCA equal to 1 means it is equivalent to global average. For the analysis, Brunei and Singapore are not included because food export share are very low. China is included due to its size of export. Although the shares of food export of China to its total export is not so high but the value is large.

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Appendix 1 Sector Classification of Input Output Table

Original Code (180 Sectors)	Code (32 Sectors)	I-O Code (43 Sectors)	Items (32 sectors)
001–029	001		Agricultural products
		0001	Paddy
		0002	Vegetable
		0003	Fruit
		0004	Livestock
		0005	Poultry
		0006	Other agricultural products
		0007	Fishery
031–041	002	0008	Mining
042–061	003		Food industry
		0009	Slaughtering
		0010	Processed Meat
		0011	Rice-based product
		0012	Processed fruit and vegetables
		0013	Processed fish
		0014	Other processed food
059, 062–064	004	0015	Other beverage
065–066	005	0016	Tobacco and tobacco manufactures
067–074	006	0017	Textile ;including spinning, weaving, knitting
072	007	0018	Wearing apparels
075–077	008	0019	Leather, foot wear
078–080, 091	009	0020	Wood product
081–083	010	0021	Paper, printing
084, 085, 087–090, 092	011	0022	Chemical product
086, 093, 094	012	0023	Petrochemical, gas
095–098	013	0024	Rubber, tires, plastic
099–104	014	0025	Non-metal product, glass
105	015	0026	Iron and steel
106–111	016	0027	Secondary steel, non-ferrous metal, metal
112–115	017	0028	Machinery
116, 117	018	0029	Office equipment and industrial machine (Office Equipment)
118, 119	019	0030	TV-radio, telecommunication equipment, electronic appliance (Electronic Appliance)
120–122	020	0031	Wire, cable, supplies, motor
123, 124, 128	021	0032	Transportation equipment
125	022	0033	Motor vehicle
126, 127	023	0034	Ship and motorcycle
057, 129–134	024	0035	Others
135, 136, 137	025	0036	Public utility
138–144	026	0037	Construction
145	027	0038	Wholesale
146	028	0039	Retail
149–158	029	0040	Transportation Services
147, 148	030	0041	Services ;hotel and restaurant
159–178	031	0042	Other services
180	032	0043	Unclassified

Note: Code and short name in parentheses are used in the paper for convenience
Source: Author's classification