A Future Economic Model: A Study of the Impact of Food Processing Industry, Manufacturers and Distributors in a Thai Context

Maliwan SARAPAB[1], Duangrat TANDAMRONG[2]

Abstract

Purpose: This study attempted to analyze the impacts of the backward linkage and output multipliers, and investigate the price fluctuation and the price forecast amongst the manufacturing sectors associated with food processing industrial output of Thailand. **Research design, data and methodology:** The Thailand Input-Output table with a size of 180 x 180 sectors from 2005, 2010, and 2015 was utilized while the secondary data of the time series from January 2002 to December 2021 were processed via a multiplicative model and Box-Jenkins model. **Results:** The backward linkage analysis indicates that canning and preserving of the meat sector majorly utilized the factors of production from the slaughtering sector; canning and preservation of fish and other seafoods sector largely used those factors from the ocean and coastal fishing sector; and the sugar sector used those of the sugarcane sector. Notably, the output multiplier analysis indicated that output multipliers of those 3 manufacturing sectors were highly increased; meanwhile the price fluctuation continually existed in all forms. Besides, the price forecast suggested that prices of chicken and sugarcane tended to be higher; whereas, the price of shrimp was unstable. **Conclusions:** Food processing industry contains the favorable components to be one of the industries of the future of Thailand.

Keywords: Distributors and Manufacturers, Food Processing Industry, Economic Linkage and Multiplier, Price Fluctuation and Forecast.

JEL Classification Code: Q11, Q12, Q14, Q18

1. Introduction

The industrial output has a significant role in Thailand's economy. Namely, through many decades, Thailand has continually developed its economy and industrial outputs thereby shifting from an agricultural country to a modern industry nation and due to its secured agricultural production base and high manufacturing performance to afford both domestic and foreign distributors, Thailand is able to link all these to the other manufacturing activities as

1 First Author. PhD candidate, Doctor of Philosophy Program in Business Administration and Digital Innovation, Mahasarakham Business School, Mahasarakham University, Thailand.
Email: 63010960001@msu.ac.th
2 Corresponding Author. Advisor, Mahasarakham Business School, Mahasarakham University, Thailand.
Email: duangrat.t@acc.msu.ac.th

the supporting industries together that further empower a high employment rate and national income. These also are a crucial part in promoting the GDP growth since these industrial outputs are the main sector or 39.2% of the DGP and one of the most important industrial outputs for Thailand's economy are those associated with the food processing industry (Bhongchirawattana, 2021).

The food processing industry is one of the astounding businesses with a distinguished growth especially under the Eastern Economic Corridor (EEC) Development Plan since it is one of the first five S-curve industries stipulated by the Ministry of Industry with the advantages from the basic factors; for example, fertility of natural resources and agricultural materials as well as the world-recognized food production safety reflecting that Thailand is capable and well-prepared to become one of the world food production hub in the near future and these fertility also takes part in pushing forward and transforming the food processing industry into the sector of industry 4.0 (Chummee, 2022).

According to a previous study by Kumpirarusk and Rohitratana (2018) on the industry 4.0 as the future industry of Thailand in which in-depth study and comparison were conducted on the opportunity and potential of the 10 targeted industries, it was discovered that Food for Future is one of the three industries with best potential to become the future industry.

At this point, the export value index from the Bank of Thailand indicates that food processing output regularly earned up to a maximum of 50,000,000 million Baht per year and, through the last decades, the value had increased from 507,878.47 million Baht in 2012 to 539,936.58 million Baht in 2018 before it was drastically cut down to 502,466.67 million Baht during the first and second quarters of 2020 due to the worldwide effect of the Covid-19 pandemic. During the 3rd and 4th quarter of 2020, the value was only slightly decreased because the product in a group of instant foods, canned seafoods, and canned fruits could be sold regularly. In fact, the decreased value resulted from falling numbers of tourists entailing a smaller amount of the processed foods sold in hotels, restaurants, bars, and nightclubs (Ministry of Commerce, 2021).

According to the export value of food processing industrial output as suggested by Bank of Thailand during 2011 – 2020, canned and processed products of fish, shrimp, and crab meat had the highest export value of 1,336,026.81 million Baht in which canned fish, shrimp, and crab meat were Thailand's most important food processing industrial output from fishery followed by sugar with the second highest export value of 950,617.48 million Baht and it also was Thailand's most important agriproduct processing industrial output, and canned duck and chicken meat had the third highest export value or 739,813.35 million Baht and the canned and processed products of duck and chicken

meat were also Thailand's most important livestock processing industrial output. These were the top three sectors of food the processing industry with the largest export value in Thailand. Consequently, these three manufacturing sectors could link all the economic activities to one another from the upstream to the downstream and this linkage could completely end within the country (Ministry of Commerce, 2021).

On the other hand, the data from Chummee (2018) suggest that a higher material cost becomes a problem and an obstruction for a production business start-up with the factors of production from the food processing industry; meanwhile, the major policies from the government, such as the promotion policy and measure for agriproduct processing industry, credit assistance measures, and investment promotion measures, were not comprehensive and did not exactly solve the problems; therefore, these have recently become the problem and obstruction in the food processing business.

From the abovementioned, the researcher was encouraged to investigate a future economic model: A study of the impact of food processing industry, manufacturers and distributors in a Thai context where a research hypothesis addressed that the food processing industry has the potential to be an industry of the future of Thailand and this is the main focus of this study. Particularly, this study considers the benefits and values for the government, private sector, and all the businesses associated with the food processing industry, manufacturers and distributors in a Thai context and to help them understand more and be able to analytically estimate the cost as well as making a suitable production plan so they could properly adjust themselves to effectively handle the future. Hence, this research is aimed to:

1) Analyze the impacts of the backward linkage amongst the manufacturing sectors related to food processing industry toward the major economic sectors of Thailand.

2) Analyze the economic impacts of the manufacturing sectors related to the food processing industry using the output multipliers.

3) Analyze the price fluctuation and prediction of the manufacturing sectors related to the food processing industry.

2. Literature Review

2.1. Input-Output Table

Bhongchirawattana (2021) examined the economic impacts of future industries of Thailand and aimed to analyze the linkage and the economic impacts of future Industries in Thailand where the 10 target S-curve industries

were considered in two forms as the "New Engine of Growth." using a 180 x180 Input-Output Table (I/O). The findings revealed that, according to I/O analysis, the first S-curve mostly relied on fertilizers, pesticides and wholesale trade. The outputs were distributed to restaurants and drinking places, i.e., coffee and tea cafes. The second S-curves mostly relied on petroleum refineries, petroleum, and natural gas. The outputs from the latter were distributed to radio, television, and related services. According to output multipliers analysis, it was found that for all 10 target industries, the components of future industries in Thailand had higher output multipliers from 2000 to 2015. In conclusion, those 10 groups of S-curve are firmly suitable to be "New Engine of Growth" or as of the industries of the future of Thailand.

Kumpirarusk and Rohitratana (2018) studied the industry 4.0 future industries of Thailand as their research objective was to study and compare the opportunities and potentials of the 10 target S-curve industries and to select the first three target industries with best potentials. Practically, this qualitative research used an analysis of secondary data and conducted the focused groups to collect additional primary data. The findings revealed that the first three highest potential industries included 1) Food for the future, 2) Biotechnology (including parts and spare parts, maintenance and repairmen); and 3) Overhaul for aerospace, and these industries are capable to be the future industries of Thailand.

Thiangtong et al. (2017) studied the impact on international trade of the sugarcane industry in ASEAN to analyze the productivity impact of the sugar industries for the ASEAN countries when the tariff of commodities, especially sugar, fell to 0% after the ASEAN Economic Community (AEC) emerged. Using the Input-Output table (I/O), the findings revealed that Thailand is the largest sugar exporter in ASEAN.

2.2. Price Fluctuation

Muenthaisong et al. (2020) previously explored the sustainable development of sugar and the sugarcane industry under economic and social changes with an aim to analyze the impact of the prices fluctuation on the sugarcane production industry in Thailand after the floating price of sugarcane. The Multiplicative Model was implemented to project the movement pattern according to the trends, seasons, cycles and irregularities to define Pearson's correlation coefficient of those factors. Then, the Box-Jenkins method was used to develop a predictive model to predict the suitable prices for sugarcane and sugar. The study found that, after the floating price of sugarcane, the volatility of sugarcane and sugar prices occurred in all forms of occurrences and continuous occurrences which was the opposite to before the floating sugarcane price.

Singh (2016) aimed to investigate the technological change and the output growth in the sugar industry in India, and notably found that sugar price could be fluctuated by fuel price due to the use of technology to transform sugarcane and molasses into ethanol which, when mixed with fuel, can be a renewable energy for cars and this caused an extreme fluctuation in the sugar price in the world market.

Pop et al. (2013) previously explored the relationship in the sugar market between the price fluctuation and its impact on Romania and found that, in the past, sugar was one of the agricultural crops with the most fluctuated prices; therefore, it was more difficult to make any good production plan for sugar compared to other crops.
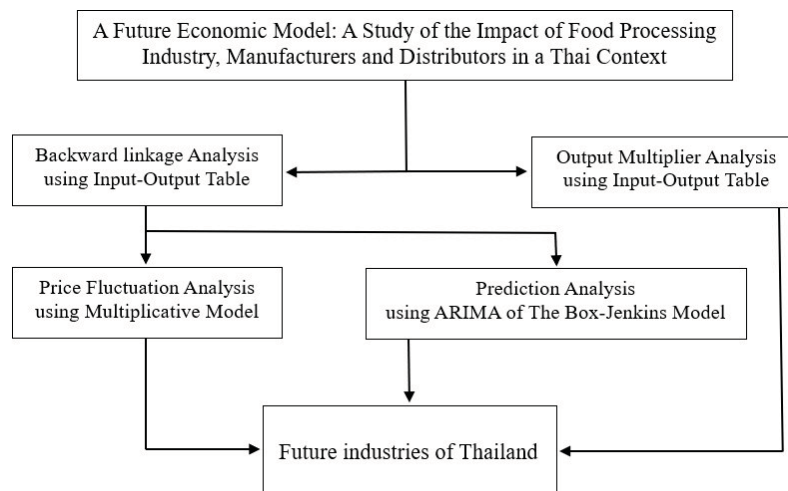

Figure 1: Research Model

3. Research Methodology

3.1. Source of Data

The researcher started this study by analyzing and identify a backward linkage and output multipliers using an Input-Output Table (I/O table) from the Office of Economic and Social Development Council together with the data of 700 manufacturing sectors recorded every five years (2005, 2010, and 2015) and the convertor of the I/O table classification was in a size of 180 x 180 sectors. Indeed, the I/O table represents a systematic summarization of all of economic activities executed in a country where those activities are classified by their associated sectors. This I/O table helps us understand more about an economic structure based on any relationships between the food processing industrial outputs and all the related manufacturing sectors. Namely, when these relationships can be identified, one top sector from each of the three food processing industries will be singled out to create a backward linkage and used to analyze price fluctuation of raw material and to forecast the price of raw material.

3.2. Data Analysis and Statistics

3.2.1. Backward linkage and Output Multiplier Analysis

According to the I/O codes, it was defined that: 1) Sector 043 was the canning and preserving of meat sector representing the livestock-based food processing industry in which the price of chicken represented the I/O table of Sector 043 which encouraged the greatest use of the production factors within a country; 2) Sector 046 was the canning and preservation of fish and other seafoods sector representing the fishery-based food processing industry in which the price of shrimp represented the I/O table of Sector 046 which encouraged the greatest use of the production factors; and 3) Sector 055 was the sugar sector representing the agricultural product processing industry in which the sugarcane price represented the I/O table of Sector 055 which encouraged the greatest use of the production factors.

Backward linkage replaced the expected factors in the equation below.

$$U_j = \frac{\sum_i^n X_{ij}}{x_j} \qquad (1)$$

Where U_j = Backward linkage
x_j = Sector j Output
x_i = Sector i Output
n = Total number of economic sectors within an economy system

$\sum_i^n X_{ij}$ = Total number of Sector i Output used as the factors of production in other economic sectors

Output Multiplier replaced the expected factors in the equation below.

$$Q = (I-A)^{-1} F \qquad (2)$$

Where Q = Vector of output value in each of the economic sectors
F = Vector of final demand in each of the economic sectors
$(I-A)^{-1}$ = Output multipliers as a NxN variable matrix

3.2.2. Price Fluctuation and Prediction Analysis on the Sectors Related to Food Processing Industry

Furthermore, the study on the price fluctuation used a multiplicative model to observe the price movement by trend, seasons, cycles, and irregularity; meanwhile, the price forecast was performed via an ARIMA of The Box-Jenkins model. All the used data were the secondary monthly timeseries in which the prices of chicken, shrimp and sugarcane were recorded from January 2002 to December 2021.

Price fluctuation analysis using a multiplicative model replaced the expected factors in the equation below.

$$P_{chicken}(Y) = T \times S \times C \times I \qquad (3)$$
$$P_{shrimp}(Y) = T \times S \times C \times I \qquad (4)$$
$$P_{cane}(Y) = T \times S \times C \times I \qquad (5)$$

Where $P_{chicken}(Y)$ = Time series of chicken price
$P_{shrimp}(Y)$ = Time series of shrimp price
$P_{cane}(Y)$ = Time series of sugarcane price
T = Long-term trend
S = Seasonal price movement index
C = Cyclical price movement index
I = Irregular price movement index

Price forecast based on the time series analysis using the Box-Jenkins model which replaced the expected factors in the equation below.

$$\hat{Y} = \hat{T} \times \hat{C} \qquad (6)$$

Where $\hat{Y}$ = Time series of price
$\hat{T}$ = Estimate of trend component
$\hat{C}$ = Estimate of seasonal change component

4. Results

4.1. Backward Linkage Analysis

Table 1: Backward linkage of the first three sectors mostly associated with food processing industrial outputs

I-O Code	Sectors associated with food processing industrial outputs	I-O Code	Backward linkage	2005	2010	2015	Means
043	Canning and preserving of meat	042	Slaughtering	50.91	52.95	54.43	52.76
046	Canning and preservation of fish and other seafoods	028	Ocean and coastal fishing	26.80	24.59	30.92	27.43
055	Sugar	009	Sugarcane	27.78	35.37	45.01	36.05

Table 1 presents that, in 2005, 2010, and 2015, canning and preserving of the meat sector had the highest backward linkage (52.76%) with the slaughtering sector and this sector covers the activity of slaughterhouses and products such as fresh meat, pork, chicken and duck. Also included are hides of cattle and buffalo, feathers of chicken and duck, buffalo horns and other by-products of cattle, buffalo, swine, chicken and duck. Especially in 2005, the proportion of this sector was 50.91% and it was later increased to 52.95% in 2010 and 54.43% in 2015, respectively.

Additionally, the sector of canning and preservation of fish and other seafoods had the highest backward linkage (27.43%) with the ocean and coastal fishing sector. Covered in this sector are ocean fishing, coastal fishing and coastal fish cultivation. In 2005, the proportion of this sector was 26.80% and it was later decreased to 24.59% and increased to 30.92% in 2015.

Similarly, the sugar sector had the highest backward linkage (36.05%) with the sugarcane sector. The only product included in this sector is sugarcane which includes both varieties to be consumed by household and industrialized. In 2005, the proportion of this sector was 27.78% and it was later increased to 35.37% in 2010 and 45.01% in 2015, respectively.

4.2. Output Multiplier Analysis

Table 2: Output multipliers of the three sectors related to food processing industrial outputs

I-O Code	Sectors associated with food processing industrial outputs	2005		2010		2015	
		Multiplier	No.	Multiplier	No.	Multiplier	No.
043	Canning and preserving of meat	2.6144	2	2.6993	2	2.6162	2
046	Canning and preservation of fish and other seafoods	1.8420	48	1.9672	45	1.9192	50
055	Sugar	1.8612	42	1.8616	62	1.9420	47

Table 2 shows that in 2005, 2010, and 2015, the output multipliers of those three sectors were greater and this described an increasing amount of the outputs in all sectors. Particularly in 2015, the output multipliers of canning and preserving of the meat sector was second of 180 sectors describing that the change in the final demand by only 1 Baht of this sector will result in a change to the outputs from all sectors by 2.6162 Baht. In the meantime, the multipliers of canning and preservation of fish and other seafoods sector was the 50th of all 180 sectors, suggesting that a change of the final demand by 1 Baht in this sector can change the outputs in all sectors by 1.9192 Baht. Similarly, the output multipliers of the sugar sector was the 47th of 180 sectors and it explained that a change in the final demand by 1 Baht in this sector can change the outputs from all sectors by 1.9420 Baht.

4.3. Price Fluctuation and Price Forecast of the Sectors Associated with Food Processing Industry

Table 3: Price fluctuation and price forecast of the three   manufacturing sectors associated with the food processing industry

Price	T	S	C		I	Price Forecast
$P_{chicken}$	Fluctuate by long-term trend	Seasonally fluctuate	4 Cycles		Irregular price fluctuation	Tend to be higher
P_{shrimp}	Fluctuate by long-term trend	Seasonally fluctuate	3 Cycles		Irregular price fluctuation	Unstable
P_{cane}	Fluctuate by long-term trend	Seasonally fluctuate	11 Cycles		No irregular price fluctuation	Tend to be higher

Table 3 shows the price of chicken fluctuated by a long-term trend, seasonally, irregularly, and by four cycles; meanwhile, the chicken price forecast during January to December 2022 disclosed that the price tended to be higher.

In the meantime, the price of shrimp fluctuated by a long-term trend, seasonally, irregularly, and by three cycles; whereas, the price forecast of shrimp during January to December 2022 indicated that the price was unstable. On the other hand, the sugarcane price fluctuated by a long-term trend, seasonally, by 11 cycles but with no irregularity and the sugarcane price forecast during January to December 2022 suggested that the price tended to be higher.

5. Discussions

The finding was that the food processing industry has the potential to be the industry of the future of Thailand. This is confirmed by the research conducted by Kumpirarusk and Rohitratana (2018) who found that the food industry for the future was the first with the best potential amongst those 10 of the targeted S-curve industries.

The study outcome on the economic linkage of the food processing industry indicated that the food processing industry consisted of the first three targeted S-curve industries and the most of them had a backward linkage with the slaughtering sector, ocean and coastal fishing sector and sugarcane sector, which was different from the study of Bhongchirawattana (2021) who found that most of the first targeted S-curve industries, the future industry of Thailand, had a backward linkage with the fertilizer and pesticides sector and wholesale trade sector. On the other hand, the study on the output multipliers of food processing industry revealed that the productivity multiplier analysis contained higher multipliers, which was similar to the result from the study of Bhongchirawattana (2021) where the productivity output multipliers of the 10 Thai targeted S-curve industries also had higher multipliers.

However, the study on the price fluctuation and forecast of Thailand's food processing industry in the future found the price fluctuation continually existed in all forms which was consistent with the study of Muenthaisong et al. (2020) who found that, after the floating sugar price, the prices fluctuation possibly happened for every dimension and anytime. In Thailand, the sugarcane price had no irregular price fluctuation in which the price is neither too high nor too low. A similar finding was found in the study of Muenthaisong et al. (2020) who found that, before the floating sugar price, the prices of Thailand's sugarcane and sugar had been subsidized by the government through the past two decades thereby taking no impact from the price volatility in the world market, which was different from the study of Singh (2016) where the sugar price in the world market was extremely fluctuated and from the study of Pop et al. (2013) who found that the sugar prices were the most fluctuated.

The findings in our research were further developed from those of Kumpirakusk and Rohitratana (2018) where the result was the same and it was consistent with those of Bhongchirawattana (2021) Still, it was noted that the result from previous studies on the backward linkage varied but it was similar in terms of the output multipliers. In this regard, even though the studies of Pop et al. (2013) and Singh (2016) on the price fluctuation and forecast found greatly fluctuated prices, Thailand had no problem from the fluctuated prices of sugarcane and sugar in the world market and it was strength for Thailand to take advantage over the competitors. Another advantage was that Thailand is the largest sugar exporter in ASEAN (Thiangtong et al., 2017). Consequently, all of the abovementioned firmly support the claim that the food processing industry has the potential to become the industry of the future of Thailand.

6. Conclusions

This paper discusses a future economic model: A study of the impact of the food processing industry, manufacturers and distributors in a Thai context. This research aimed to: 1) analyze the impact of the backward linkage amongst the manufacturing sectors related to food processing industrial outputs toward the major economic sectors of Thailand; 2) analyze an economic impact of the manufacturing sectors related to the food processing industry using the output multipliers; 3) analyze the price fluctuation and prediction of the manufacturing sectors related to the food processing industry.

Interestingly, the study outcome on the economic linkage between the manufacturing sectors associated with food processing industry and the economic sectors in Thailand disclosed that canning meat and preservation of the meat product sector majorly had a backward linkage with the slaughtering sector; canning and preservation of the fish and other seafood sector majorly had a backward linkage with the ocean and coastal fishery sector; and the sugar sector majorly had a backward linkage with the sugarcane sector.

According to the study on the output multipliers of the three sectors associated with the food processing industry, the output multipliers of those three sectors were greater and helped increased the amount of the outputs in all sectors.

After studying the price fluctuation and forecast of the three sectors associated with the food processing industry, it was discovered that the price of chicken and shrimp demonstrated four types of price fluctuation, including: 1) Price fluctuation by a long-term trend; 2) Seasonal price fluctuation; 3) Cyclical price fluctuation; and 4) Irregular price fluctuation; whereas, the price of sugarcane regularly fluctuated by a long-term trend, seasonally, by the cycles, but with none of irregular fluctuation. Regarding the price

forecast, the prices of chicken and sugarcane tended to be higher while the price of shrimp was unstable.

However, even though the Covid-19 pandemic drastically causes the decline in Thailand's GDP, the GDP of the food processing industry slightly decreases and after taking a deep look in all of the research objectives, we understand more about the structure of the Thailand's economic system from the past to the present and it helps us to predict the economic trends in the future as well.

In addition, as evidenced by the investigation results and the discussion described above, confirmed that the study of A future economic model: A study of the impact of food processing industry, manufacturers and distributors in a Thai context there are conclusions based on the hypothesis that food processing industry has the potential to be an industry of the future of Thailand.

This study will be beneficial and valuable to all sectors of Thailand including the government, private sector, and all the businesses associated.

For the Thai government: it will help promote the economic growth through food processing industry. The study outcome also indicates that the output multipliers of those 3 sectors are getting greater. Explicitly, canning meat and preservation of meat product sector has been ranked the 2nd of 180 sectors and the 2nd highest ranking for more than 10 years in which only a 1 Baht stimulus will help an economic sector grow by 2.6 Baht or 99% significantly. Therefore, the government must launch any associate policies or strategies that aim to develop and to empower more output multipliers, etc.

For private sectors: an investment in the food processing industry requires cost estimation and analysis in order to create a suitable production plan with an effective pricing strategy for maximum profit; therefore, the price of raw material is the key factor to the success. In this regard, the study on the raw material price fluctuation in those three manufacturing sectors notably indicates that the volatility in the sugar sector with the price of the sugarcane sector represented in the I/O table is the most favorable for investment with no irregular fluctuation because the price of sugarcane and sugar has been subsidized by the government through the past two decades so is not affected by the price volatility in the world market.

For the business sector, the study outcome suggests that the price of chicken and sugarcane seems likely to be higher in the future while the price of shrimp will shift back and forth between high and low prices so that an entrepreneur can securely design a well-organized plan for the production cost when he knows in advance that the prices of raw materials will increase and it might somehow entail higher production cost in the future. Consequently, the entrepreneur needs to fix a good price that should suit the products in the long term because it is annoying for customers if the product's prices keep changing and this may end up in losing the regular customers. After all, this can be another business advantage for an investor.

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