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### An Evaluation of the Expiration of EU's GSP in Food Industry in Thailand: Cointegration, Bridge Matrix and Input-Output Analysis

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**Abstract:** In 2014 and 2015, food industry in Thailand confronts with the challenge affected by the expiration of the European Union (EU)'s Generalized System of Preference (GSP). This paper aims to investigate the impacts of the expiration of GSP by calculating the value of sectoral output after the GSP was expired. The integrated quantitative approach, including Johansen's cointegration, bridge matrix and Input-Output table, were employed. First, the behavioral equations of processed-food-related exports to EU was estimated by applying the Johansen's cointegration method. The estimated equation shows the negative impacts of expiration of GSP on Thailand's processed-food-related exports with statistical significance. The cutting of GSP leads to a 150.48 million baht decline in exports in food industry. Second, the decreasing of processed-food-related exports was distributed into final demand in 10 sectors by using bridge matrix; a matrix which is based on Thailand's 2005 input-output table. The decreasing in final demand in 10 sectors and the inverse Leontief's matrix were used to calculate the value of output in 180 sectors. The results indicated that output in 165 sectors will decrease in response to the expiration of GSP. Only 15 sectors showed no change in their output after GSP was expired. The value of output in 165 sectors will decrease 299.09 million baht or only 0.16 percent. The result explores that it is a slight impact of expiration of GSP on aggregate output in Thailand. Finally, the output multiplier and household income multiplier were calculated in order to evaluate the effectiveness of changing in final demand of 10 sectors in food industry on output and household income. The results show that both output multiplier and household income multiplier are small in comparing with the total multiplier. The conclusion is that there is a slight impact of the expiration of GSP on sectoral output in Thailand. However, the empirical results also indicate that the impacts of the expiration of GSP are limited in only in food industry. Therefore, the Thai government should set up a measure which is focused on food industry in order to abate the impact of expiration of GSP.

**Keywords:** Input-Output Table, Bridge Matrix, Food Industry in Thailand.

#### 1. INTRODUCTION

In 2014 and 2015, food industry in Thailand confronts with the challenge affected by the expiration of the European Union (EU)'s Generalized System of Preference (GSP). Table 1 indicates that there are 10

subsectors in food industry, which applied the EU's GSP. For fruits, ocean and coastal fishing, canning of fruits and vegetables, canning of preserving fish, coconut and palm oil, sugar, and other food products, these subsectors have been applied EU's GSP higher than 80 percent. Therefore, the expiration of EU's GSP may generate the impacts on food industry and also on Thai industry. This paper aims to investigate the impacts of the expiration of EU's GSP by calculating the value of sectoral output and multiplier after the GSP was expired. The results will be used to setup an appropriate policy to cope with the expiration of EU's GSP.

**Table 1**  
**Food Export to EU under GSP**

Sector	Coverage
8 Fruits	the production of oranges, grapes, durians, rambutans, mangoes, pineapples, water melons, bananas, mangosteens, pomeloes, longens, jack fruits, lychees and other fruits not mentioned elsewhere
28 Ocean and Coastal Fishing	ocean fishing, coastal fishing and coastal fish-cultivation
45 Canning of Fruits and Vegetables	dried and frozen fruits, canned and bottled fruits and vegetables, fruit and vegetable juice, jam, jellies and others
46 Canning Preserving of Fish	frozen fish, salted and dried fish and preserved fish
47 Coconut and Palm Oil	coconut oil, palm oil, coconut cake and palm cake
53 Bakery Products	all bakery products such as bread, cake, pies, crackers
54 Noodles and Similar Products	noodles of all kinds such as yellow noodles, white noodles made from rice flours, spaghetti, macaroni, etc. Also included in this sector is the production of instant noodles
55 Sugar	refined sugar made from sugar-cane and coconut tree as well as the by-products of sugar such as syrup, molasses and bagasse
60 Other Food Products	soy sauce, bean curd, fish sauce, vinegar, salted and fermented eggs, spices, table salt, other sauces and other prepared food
61 Animal Feeds	the production of all kinds of animal feed such as chicken feed, fish meal.

Source: NESDB

## 2. MODEL AND METHODOLOGY

The integrated quantitative approach, including Johansen's cointegration, bridge matrix and Input-Output table, were employed to show the impact of EU's GSP expiration on Thai industry. There are 4 steps that are applied in this paper. First, the behavioral equation of exports in processed-food-related to EU is set up to find the determinants of exports in processed-food-related to EU. Second, the input-output table of Thai economy presented by National Economic and Social Development Board (NESDB) is employed to identify the bridge matrix. This matrix is used to distribute the exports in food processing product to EU into the sectoral level. In the third step, Leontief's inverse matrix is used to calculate the sectoral final output. The final step is to calculate the multiplier including total output multiplier and household income multiplier.

For the first step, the behavioral equations of exports in processed-food-related to EU was constructed based on excess demand concept and Chaivichayachat (2007). The behavioral equation of exports in processed-food-related to EU is

$$EXF = f(E, P_x/PEU, Y, P_w, GSP) \tag{1}$$

where  $EXF$  is exports in processed-food-related to EU,  $E$  is nominal exchange rate of baht against euro,  $P_x$  is export price in food processing product,  $PEU$  is food price in EU,  $Y$  is real GDP in EU,  $P_w$  is world price of foods, and  $GSP$  is the average rate of applied GSP.

This behavioral equation is estimated by using annual data during 1997-2012. The Johansen's approach of cointegration test is also applied to avoid the problem of spurious regression.

Second, the input-output table of Thai economy presented by NESDB is employed to identify the bridge matrix. This matrix is used to distribute the exports in processed-food-related to EU into the sectoral level. The final demand in input-output table is calculated as

$$X = (I - A)^{-1}D \tag{2}$$

where  $X$  is  $180 \times 1$  vector of final demand,  $I$  is the inverse Leontief's matrix  $180 \times 180$ ,  $A$  is input coefficient matrix  $180 \times 180$ , and  $D$  is  $180 \times 1$  vector of final demand.

Vector  $D$  in equation (2) includes consumption, investment, change in inventory, government expenditure and exports. Thus,  $D$  can be divided into to 2 parts: domestic expenditure (DE), including consumption, investment, change in inventory and government expenditure, and exports (EX). Therefore,

$$X = (I - A)^{-1}(DE + EX) \tag{3}$$

Vector EX contains export value in 180 sectors. The exports in processed-food-related in Thailand in aggregate level which is calculated by equation (1) can be disaggregated into sector final demand as following:

$$EX = B \times EXF \tag{4}$$

where  $B$  is  $180 \times 1$  vector, called bridge matrix.

Vector  $B$  is the linkage between exports of processed-food-related in aggregate level and disaggregate level. The calculation of bridge matrix in this paper is based on the Thai's input-output table in 2005. After adjusted, the column vector of bridge matrix is generated. Final step, sectoral final output is calculated as

$$X = (I - A)^{-1}(DE + (I - A)^{-1} B EXF) \tag{5}$$

$$\bar{O}_j = \sum_{i=1}^{n+1} \bar{\alpha}_{ij} \tag{6}$$

$$\bar{H}_j = \sum_{i=1}^{n+1} a_{n+1,i} \tag{7}$$

where  $\bar{O}_j$  is total output multiplier for  $j$  industry,  $\bar{H}_j$  is total income multiplier for  $j$  industry,  $\bar{\alpha}_{ij}$  is the element in row  $i$  th and column  $j$  th in Leontief inverse matrix, and  $n+1$  is household sector in input-output table.

### 3. RESULTS

First, the behavioral equations of exports in processed-foods-related to EU was estimated by applying the Johansen's cointegration method. Based on annual data during 1993-2005, the estimated equation is

$$EXF_t = 638.2 + 32.8E_t - 231.43(Px/PEU)_t + 745.2Y_t + 435.44Pw_t - 150.48GSP_t$$

se.                      (4.38)                      (-78.2)                      (234.1)                      (199.8)                      (76.2)

The estimated equation shows the negative impacts of expiration of GSP on exports in processed-foods-related with statistical significance. The cutting of GSP leads to a 150.48 million baht decline in exports in processed-foods-related to EU.

Second, based on the fact, the decrease in Thailand's processed-foods-related exports to EU is distributed into final demand in 10 sectors by using bridge matrix; a matrix which is based on Thailand's 2005 input-output table. The decrease in final demand in 10 sectors and the inverse Leontief's matrix are used to calculate the value of output in 180 sectors. The results indicate that output in 165 sectors will decrease in response to the expiration of GSP (Appendix). Only 15 sectors show no change in their output after GSP was expired. The value of output in 165 sectors will decrease 299.09 million baht or only 0.16 percent. The aggregate output in other services shows the largest decline of 93.23 million baht, down 8.1% from pre-expiration of GSP. The second biggest impact on the final output is air transportation sector, which shows a 35.02 million baht decrease, accounting for 1.16 percent comparing to the pre-expiration period. For other sectors that are not mentioned above, there is minimal change in final output. The result explores that it is a slight impact of expiration of GSP on aggregate output in Thailand.

Finally, the total output multiplier and the total household income multiplier are calculated in order to evaluate the effectiveness of changing in final demand of 10 sectors in food industry on total output and total household income. The calculation of total output multiplier is shown in Table 2. The total output multiplier of ocean and coastal fishing sector shows the highest rate at 2.13. The second highest multiplier is animal feed sector, followed by fruit sector which are 2.11 and 1.38 respectively. For other processed-food-related sectors, their total output multiplier are less than one. The average of total output multipliers of all 10 processed-food-related sector is quite low at only 0.98, compared to that of all 180 production sectors which is 16.31. For the change in final output, canning preserving of fish sector experiences the largest decline in final output by 44.06 million baht although its total output multiplier is at only 0.51. Likewise, sugar sector's multiplier is at only 0.68 but this sector show the second largest decrease in final output by 10.20 million baht. Meanwhile, the smallest decrease in total output is noodles and similar products sector which declines by 0.11 million baht. In summary, the results of the calculation of total output multiplier finds that multiplier of processed-foods-related sectors is low. It indicates that the expiration of EU's GSP has a slight impact on Thai processed-food-industry and other industry. For the calculation of total income multiplier, the results are shown in Table 3. The total income multiplier in ocean and coastal fishing sector shows the highest multiplier at 873.08 implying that a one baht drop in exports leads

**Table 2**  
**Total Output Multiplier**

	Sector	Change in Final Demand (Baht)	Total Output Multiplier	Change in Final Output (Baht)
46	Canning Preserving of Fish	-85,872,176.5	0.51	-44,060,129.94
55	Sugar	-14,993,454.0	0.68	-10,203,296.25
61	Other Food Products	-3,686,292.6	2.11	-7,767,506.24
60	Animal Feeds	-16,618,976.0	0.34	-5,697,571.28
45	Canning of Fruits and Vegetables	-23,684,543.0	0.15	-3,580,939.29
8	Fruits	-1,941,515.5	1.38	-2,679,837.54
47	Coconut and Palm Oil	-1,982,402.0	0.38	-745,168.81
28	Ocean and Coastal Fishing	-132,890.0	2.13	-283,634.33
53	Bakery Products	-893,233.0	0.13	-118,797.06
54	Noodles and Similar Products	-672,055.6	0.16	-106,179.58

**Table 3**  
**Total Income Multiplier**

	Sector	Change in Final Demand (Baht)	Total Income Multiplier	Change in Final Output (Baht)
46	Canning Preserving of Fish	-85,872,176.5	223.21	-19,167,743,691.25
55	Sugar	-14,993,454.0	296.31	-4,442,667,020.18
60	Animal Feeds	-16,618,976.0	136.85	-2,274,233,448.27
61	Other Food Products	-3,686,292.6	524.42	-1,933,152,537.07
45	Canning of Fruits and Vegetables	-23,684,543.0	65.88	-1,560,279,557.06
8	Fruits	-1,941,515.5	563.41	-1,093,874,735.87
47	Coconut and Palm Oil	-1,982,402.0	141.57	-280,654,286.84
28	Ocean and Coastal Fishing	-132,890.0	873.08	-116,023,074.73
53	Bakery Products	-893,233.0	57.41	-51,281,462.36
54	Noodles and Similar Products	-672,055.6	69.07	-46,417,989.98

to a decrease in final demand by 873.08 baht. The second highest multiplier is found in fruit sector, followed by animal feed sector. Those sector' total income multiplier are 563.41 and 524.42, respectively. However, the total income multipliers that related processed-foods-related are lower than the average total income multiplier with 180 sectors. The average total income multiplier of 180 sectors is 7,514.571.

#### 4. CONCLUSION

The conclusion is that there is a slight impact of the expiration of EU's GSP on sectoral output in Thailand. The impacts of the expiration of GSP are limited in only in food industry. Therefore, the Thai government should set up a measure which is focused on food industry in order to abate the impact of expiration of GSP.

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