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A Gravity Model for Indonesian Canned Tuna Exports to The European Union Market: An Application of PPML Estimator

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Abstract: In this study, we examine the determinants of Indonesian canned tuna export to the European Union (EU) market through a gravity model approach. This paper employs a gravity model approach through Poisson Pseudo-Maximum Likelihood (PPML) estimation. Data from 2006 to 2015 covering 10 countries (the Netherlands, Belgium, Italy, Germany, Poland, Portugal, Slovenia, Spain, Sweden, and the United Kingdom) were employed with HS 160414 product code specification. Constant Market Share Analysis (CMSA) was performed to examine Indonesian export growth as well as its competitors. The findings indicated that the performance of Indonesian canned tuna exports to the EU market is prominently affected by competitiveness effect while Thai canned tuna export is more affected by import growth and composition effect. The Philippines and Vietnam canned tuna exports are more affected by composition and competitiveness effect. Finally, population of the importing countries, tuna production volumes and real exchange rates significantly affect Indonesian canned tuna export to the EU.

Keywords: Canned tuna, Gravity model, CMSA, PPML

Introduction

Tuna is one of the most leading fish commodities, and becomes the third most in-demand fish commodity in the international market (FAO, 2018). The increasing public awareness of the importance of consuming white meat rather than red meat for health has increased the demand for fish broadly. Indonesia was in the sixth position as a tuna supplier to the international market (Statista, 2019). The contribution of tuna exports internationally reached 14 % of the total contribution of the fisheries sector that reached 54.1 billion rupiah in 2011 (Yusuf, Arthatiani, & Maharani, 2018; BPS, 2015). The EU is the main market for canned tuna in the world (Yusuf, Arthatiani, & Maharani, 2018). The main importing countries are the United Kingdom, France, Germany, Italy, the Netherlands,

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Belgium and Spain (Ministry of Trade, 2014). As reported by the UN Comtrade (2017), Indonesia canned tuna exports have continued to increase since 2009, while fresh tuna exports have continued to decline (UN Comtrade, 2017). The Indonesia fisheries sector as a whole contributed 8 % of Gross Domestic Products (GDP) in 2016 (Seafood-tip, 2016).

Indonesian trade flows to EU market are affected by numerous factors. Prior studies have proven that macro variables such as raw fish and seafood products (Hidayati & Masyhuri, 2015; Natale, Borello, & Motova, 2015), GDP (Rabbani, Dey, & Singh, 2011; Natale, Borello, & Motova, 2015), population (Rabbani, Dey, & Singh, 2011), exchange rates (Hidayati & Masyhuri, 2015), prices (Rani, Immanuel, & Kumar, 2014) and economic distances (Natale, Borello, & Motova, 2015) significantly affected international trade flows. However, Natale, Borello, & Motova (2015) has revealed several problems that arise in the application of the model, including zero value data that are often eliminated in panel data analysis. This is because the log-linearized model cannot work on zero observations. Zero values can be caused by the absence of trade in the year concerned, the values are below a certain threshold, data are lost, and data that are intentionally not reported. Therefore, removing this information from the dataset can eliminate important information about the effect of the independent variables being examined on the dependent variable (Grant & Lambert, 2005). Several methods have been recommended by prior studies to overcome zero values and heterokedasticity issues in the dataset such as Heckman's model proposed by Gomez-Herrera (2013), Feasible Generalized Least Squares (FGLS) proposed by Martinez-Zarzoso (2013), Helpman model proposed by Helpman, Melitz, & Rubinstein (2008), and Tobit models proposed by Martin & Pham (2015).

In this study, we performed PPML as suggested by Silva & Tenreyno (2006) to examine the effect of key macro-economic variables on the export of Indonesian canned tuna from the last 10 years. The applications of this method to the analysis of international trade have been carried out by Wei, Huang & Jun (2012), Ehrich & Mangelsdorf (2018), Wood, Wu, Li, & Kim (2017), Jayasinghe, Beghin, & Moschini (2010), Bojnec & Fert (2015), and Braha, Qineti, Cupák, & Lazor áková (2017). However, most of the empirical applications were applied to food commodities, while the applications in fisheries commodities are still limited. Therefore, this study will contribute to the economics literature by providing a new knowledge of the application of the model by including zero values of export volume of fisheries commodities. In addition, we will also discuss the growth of Indonesian canned tuna exports through CMSA approach. Finally, the rest of this study is organized as follows: in the next section we will explain the macro-economic variables involved and the gravity model specification. In the third section, we will explain data set and methods used, followed by the findings and discussion in the fourth section and summarize with the conclusions and limitations of the study.

Literature Review

International trade

Theoretically, there are two causes of international trade. First, trade occurs because of differences between one country and another. Every country gains benefit of trading on the essential commodities they need. Second, trade aims to achieve economies of scale in production. A country can choose to produce a certain number of goods on a larger and more efficient scale, then hand over the production of other goods to other countries

(Basri & Munandar, 2010). Another reason is because of the supply and demand for certain products. A country will export a commodity to another country if the domestic price of country A (before the occurrence of international trade) is relatively lower compared to the domestic price of country B. The price structure that occurs in country A is lower because its domestic production is greater than its domestic consumption. The country A has excess supply, thus it has the opportunity to sell excess production to other countries. On the other hand, the country B has a shortage of supply because its domestic consumption is greater than its domestic production, therefore higher prices occur in the country B. In this case, the country B will buy commodities from other countries which are relatively cheaper. When there is consumption between the country A and the country B, international trade between the two will occur with the price received by the two countries being the same at the equilibrium (Ministry of Trade, 2011).

Gravity model equation

Gravity model is a model used to analyze economic and non-economic factors that affect trade between two countries based on Newton's law of gravity. The model was firstly employed in the analysis of international trade by Tinbergen (1962) to analyze the trade flow in the European countries. Subsequently, the empirical analyses have been conducted by Rabbani, Dey, & Singh (2011) which indicated positive effects of GDP and population of importing countries (China, Vietnam, and Thailand). Likewise, the production has a positive effect on tuna trade flow from Indonesia to Japan (Hidayati & Masyhuri, 2015). Natale, Borrello, & Motova, A. (2015) also finds a negative effect of economic distance on seafood trade. Finally, Rani, Immanuel, & Kumar (2014) proves a significant effect of price and exchange rates on the volume of ornamental fish exports to the world.

In this study, we employs the PPML estimation approach. The advantage of the method is the ability to overcome the problem of log-linearized and non-linear transformation which leads to the problem of heteroscedasticity that often occurs in panel data processing. In addition, log-linearized models are not suitable to be performed in zero value data, thus researchers are often forced to eliminate the relevant observations with zero trade values which cause a biased coefficient estimation. The use of the method is also proven to produce a constant elasticity (Silva & Tenreyro, 2006). The problem of heteroscedasticity is overcome by creating a variance V[yi|x] proportionally to the mean E[yi|x]. The variance is assumed to be constant and to all observations are given the same weights (Silva & Tenreyno, 2006). The PPML estimator is obtained through the following equation:

$$\sum_{i=1}^{n} [y_i - \exp(x_i \widetilde{\beta})] x_i = 0 \qquad (1)$$

Based on the arguments above, the hypotheses proposed in this study are:

H1. The GDP of importing countries has a positive effect on Indonesian tuna exports to the EU market.
H2. The real exchange rate has a negative effect on the Indonesian tuna exports to the EU market.
H3. The Indonesian tuna production has a positive effect on the Indonesian tuna exports to the EU market.

H4. The economic distance between Indonesia and importing countries has a negative effect on the Indonesian tuna exports to the EU market.
H5. The population in importing countries has a positive effect on the Indonesian tuna exports to the EU market.

Methods

Data sources and analysis

The data employed in this study were collected from 2006 to 2015 covering 10 countries in the EU (the Netherlands, Belgium, Italy, Germany, Poland, Portugal, Slovenia, Spain, Sweden, and the United Kingdom). The selection of the countries was based on consideration of the data availability and all of those countries were the main export destinations for Indonesian canned tuna in the EU. The export volumes of canned tuna were collected from UN COMTRADE with HS 160414 code specifications. GDP and population data of importing countries were collected from World Bank, economic distance from CEPII, real exchange rates from UNCTAD and tuna production from Fishstat-FAO. To provide an overview of the growth of Indonesian canned tuna exports, CMSA method was performed. Afterwards, a panel data regression with PPML approach was performed to analyze the factors that significantly affect the export of Indonesian canned tuna to the EU market.

Constant Market Share Analysis (CMSA)

CMSA is used to analyze the growth of exports in a country based on export growth rate through three effects; import growth effect, composition effect, and competitiveness effect. The method is employed to measure a country's competitive advantage which is based on the assumption that an average export growth rate of a country can be at the same level, lower, or higher than the average growth rate of world exports. The import growth and composition effects are analyzed from the demand side, while the competitiveness effect is analyzed from the supply side.

The import growth effect analyzes whether an exporting country has focused its exports on the destination market, which has a tendency to increase demand aligned with the world demand. The composition effect analyzes the difference in exports that occurs due to demand from the destination market. Positive values indicate that the exporting country has the right market choice and vice versa. The competitiveness effect analyzes the competitiveness of exporting countries' commodity by measuring the difference in the export growth with the import growth. A country has a high competitiveness when the exports grow faster than the import market which leads to an increase in the market share of exporters in the destination market (Merkies & van der Meer, 1988).

The CMSA equation is written as follows (Learner & Stern, 1970):

$$X_{i,jk}^2 - X_{i,jk}^1 = m_i X_{i,jk}^1 + \left\{ (m_i - m) X_{i,jk}^1 \right\} + \left\{ X_{i,jk}^2 - X_{i,jk}^1 - m_i X_{i,jk}^1 \right\} \qquad (2)$$

Where:

$X^2_{i,jk}$	= Export value of canned tuna from country j to k in the year-t
$X^1_{i,jk}$	= Export value of canned tuna from country j to k in the year-(t-1)
m_i	= Increase of canned tuna imports in country k (%)
m	= Increase of canned tuna imports in country k from the world (%)
$m_i X^1_{i,jk}$	= Import growth effect
$\{(m_i - m)X^1_{i,jk}\}$	= Composition effect
$\{X^2_{i,jk} - X^1_{i,jk} - m_i X^1_{i,jk}\}$	= Competitiveness effect

Poisson Pseudo-Maximum Likelihood estimation (PPML)

We employed five independent variables to explain the dependent variable of canned tuna export volume. Data analysis was carried out by employing the gravity model approach and the PPML method through Microsoft Excel 2007 and STATA 13 software package. The dependent variable was not transformed into a log-linear form as suggested by Silva & Tenreyno (2006) to allow Indonesia's zero export volumes to be included in the analysis. Furthermore, to avoid estimating the independent variable values that were too large, the log-linear transformation was only performed on the independent variables. Following the PPML assumption, we performed fixed effect (FE) as the best model in the analysis. Based on above explanation, the specification model to be tested in this study is as follows:

$$Vex_{ijt} = \beta_0 + \beta_1 lnGDPC_{jt} + \beta_2 lnER_{ijt} + \beta_3 lnPROD_{jt} + \beta_4 lnED_{ijt} + \beta_5 lnPOP_{jt} + \varepsilon_{ijt} \qquad (3)$$

Where:

Vex_{ijt}	= Export volumes of Indonesian canned tuna to importing countries j (Tons)
β_0	= Constant
$\beta_1 - \beta_n$	= Estimated parameters
GDP_j	= GDP of importing countries j (US \$)
ER_{ij}	= Indonesian real exchange rates (RP/US \$)
$PROD_i$	= Indonesian canned tuna production volumes (Tons)
ED_{ij}	= Economic distance between Indonesia to importing countries j (Km)
POP_j	= Population of importing countries j (People)

The dependent variable used in this study is the total export volumes of Indonesian canned tuna while independent variables are GDP of importing countries, Indonesian real exchange rates, Indonesian canned tuna production volumes, economic distance between Indonesia and importing countries, and population of importing countries. The variable operational definitions are indicated in the Table 1.

Table 1. **Variable operational definitions**

Variables	Conceptual definition	Operational definition
Vexijt	The number of items sold (Daryanto, 2011)	The total export volumes of Indonesia's canned tuna exported to importing countries from 2006 to 2015 (Tons)

LnGDPj	A market value of all goods and services produced by domestic production factors for a certain period of time (Salvatore, 1997)	A market value of goods and services produced by production factors in importing countries from 2006 to 2015 (US $)
LnER$_{ij}$	The exchange rates that are used to exchange goods and services from a country to others (Mankiw, Quah Euston & Wilson Peter, 2012)	The exchange rates between Indonesia and the importing countries for canned tuna (Rp/US $) and obtained by the following equation (Mankiw, Quah Euston & Wilson Peter, 2012): *Real exchange rate = Nominal exchange rate x (Consumer Price Index of Indonesia/Consumer Price Index of importing countries)*
LnPROD$_i$	Activities to produce goods and services (Downey & Erickson, 1992)	Total tuna production of Indonesia from 2006 to 2015 (Tons)
LnEDij	A distance between two countries which is measured based on bilateral distance between large cities in both countries (Mayer & Zignago, 2011)	The distance between Indonesia and the importing countries which is used as a proxy for transportation costs (Km) and obtained by the following equation (Mayer & Zignago, 2011): *Economic distance= Distance between two countries x (GDP of importing countries/Total GDP of all countries analyzed)*
LnPOPj	All residents living in a country without considering differences in legal status or citizenship (World Bank, 2017)	All residents of importing countries from 2006 to 2015 (People)

Source: Daryanto (2011), Downey & Erickson (1992), Mankiw, Quah Euston & Wilson Peter (2012), Mayer & Zignago (2011), World Bank (2017), and Salvatore (1997)


Findings

Overview of Indonesian canned tuna exports

Tuna as one of Indonesia's main export commodities in the world market is generally traded in the form of fresh, frozen, canned (preserved), and fillets in vacuum containers (UN Comtrade, 2017). There has been a positive trend of Indonesian canned tuna exports over the past 15 years to the international market. In 2003, the total export volume of canned tuna was only 46,845,915 tons and increased to 71,887,505 tons in 2017. Compare to frozen tuna, the total export volume in 2003 was 42,451,401 tons and increased to

102,601,756 tons in 2017. The total export volume of fresh tuna was 27,778,108.58 tons in 2003 and decreased to 3,951,470 tons in 2017. The average growth of Indonesian canned tuna exports (3.56%) was still under the frozen tuna (15.13%) while fresh tuna indicated a negative growth rate (-10.17%) (Figure 1).

Figure 1. **The development of Indonesian tuna export volumes in the international market**
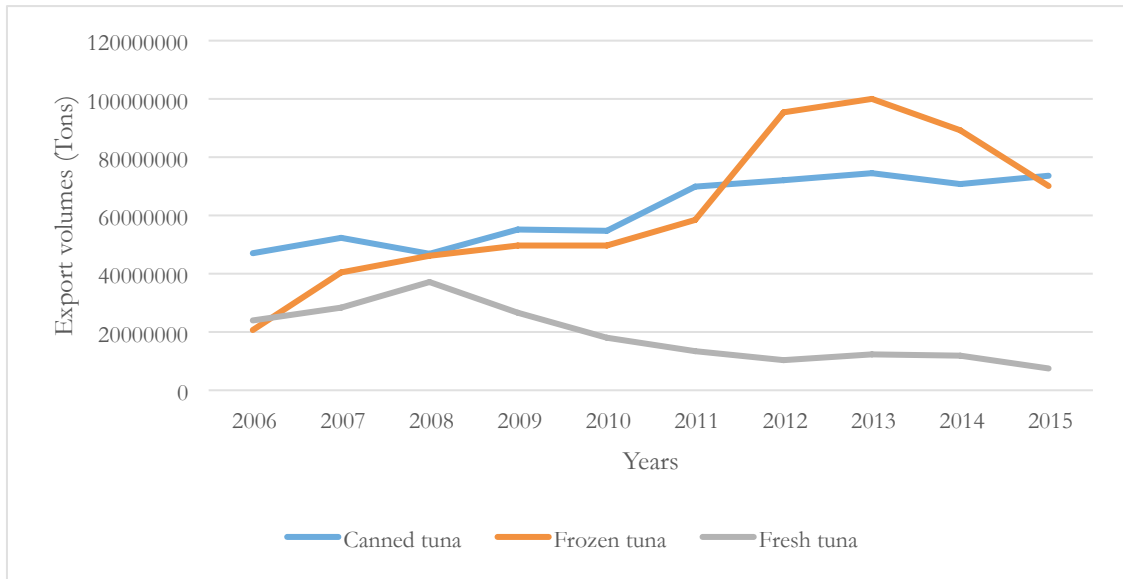
Source: UN Comtrade (2016)

The preeminent market destination for Indonesian canned tuna is the USA with total export volume of 11,161,013 tons in 2017, followed by Japan (10,481,118 tons), Italy, Australia (4,257,997 tons), the United Kingdom (3,858,276 tons), Spain (3,300,513 tons) and the Netherlands (1,089,914 tons). Cumulatively, the EU is the main market for Indonesia with a total export volume of 18,112,086 tons (UN Comtrade, 2017) (Figure 2).

Figure 2. **The main destination countries in the world, 2017**
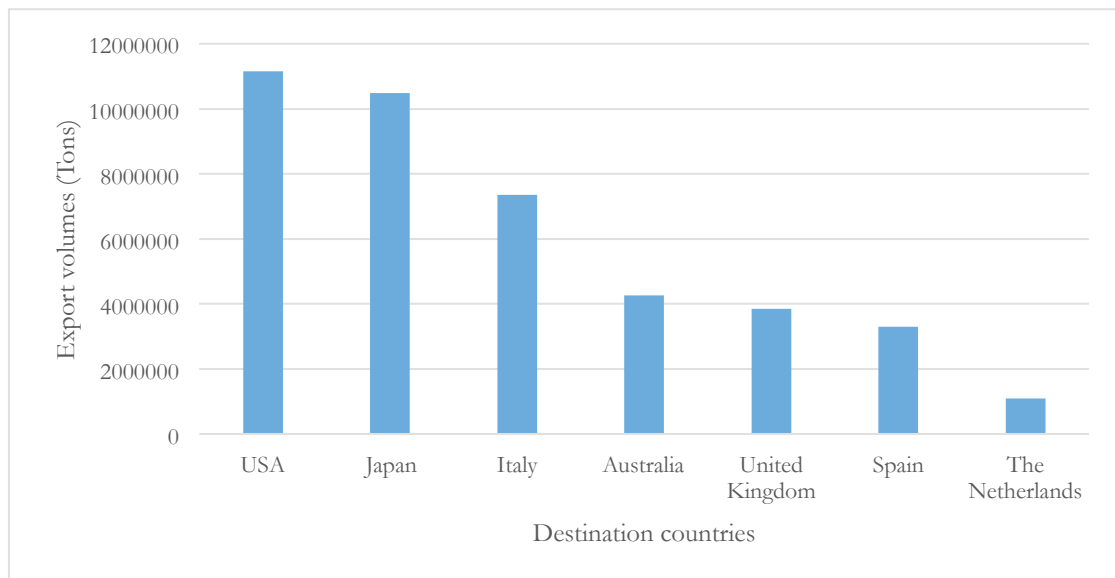
Source: UN Comtrade (2018)

Italy is the main export market with export volume of 7,345,459 tons or 28 % of the total volume of Indonesian canned tuna exports in 2017, followed by the United Kingdom (3,858,276 tons or 14 %), Spain (3,300,513 tons or 12 %) and the Netherlands (1,089,914 tons or 4 %) (Figure 3). Canned tuna has become an alternative products that offer relatively lower prices than fresh or frozen tuna. Currently, there is an increasing demand of the product in the EU market. Some countries have even switched from Yellowfin and Albacore to Skipjack which is cheaper as raw material with lower quality. Spain and France have applied this strategy to generate high demand and very low market prices (FAO, 2016). Other Asian countries such as the Philippines, Thailand and Vietnam are the other major exporters of canned tuna products to the EU with Thailand as the main exporter (Jiménez-Toribio, Guillotreau, & Mongruel, 2010).
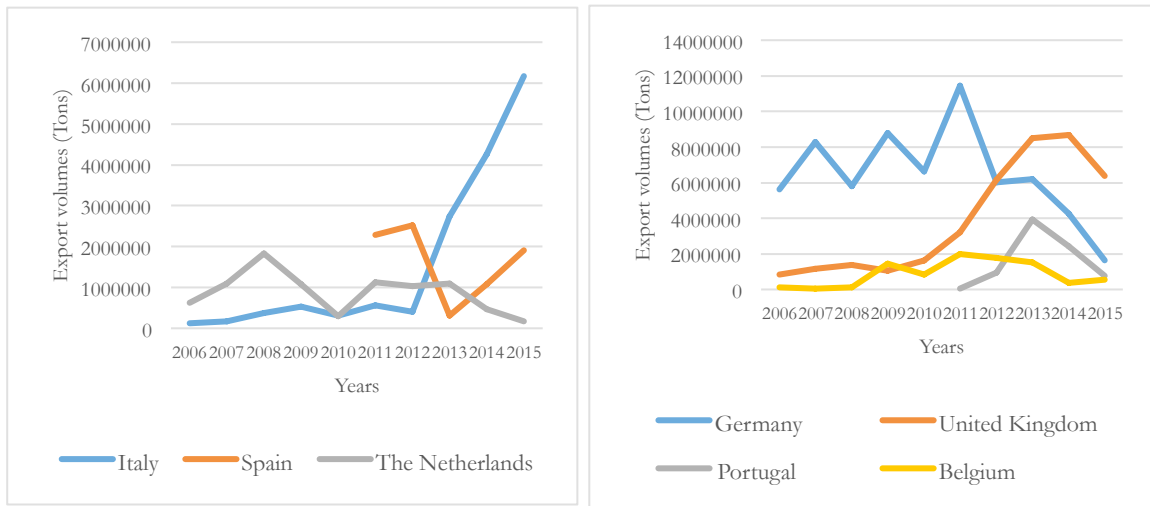
Figure 3. **The main destination countries in the EU, 2017**
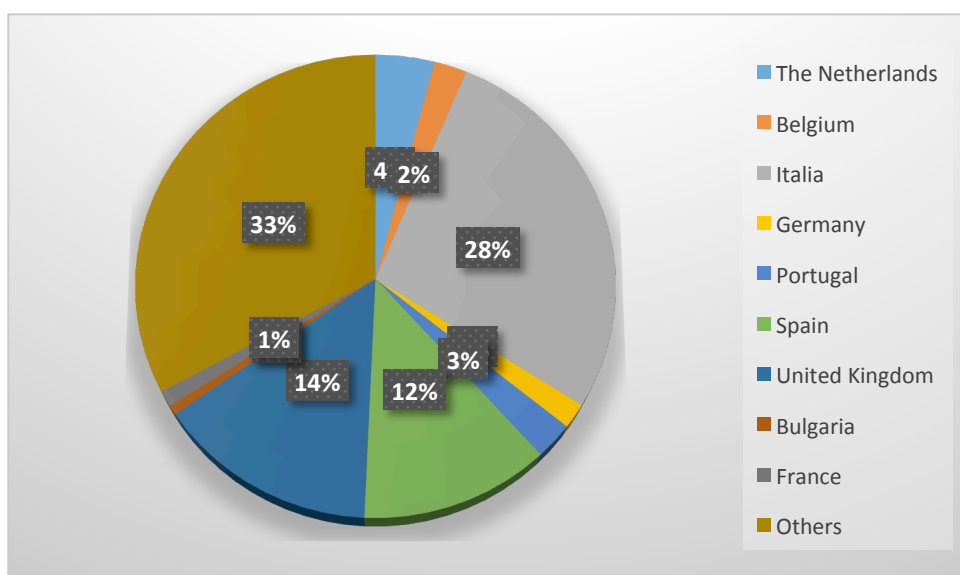
Source: UN Comtrade (2018)

There are increasing demands in Italy and Spain. On the other hand, the Netherlands dealt with a downward import trend compared to 2008, yet it experienced an upward trend from 2015 to 2017. On the contrary, Germany has indicated a downward trend since 2012 which similarly to the United Kingdom and Portugal since 2013. Belgium indicated a downward trend from 2011 to 2016, yet it experienced a slight increase in 2017 (Figure 4).

Figure 4. **The development of the volume of Indonesian canned tuna exports to the EU countries**

Source: UN Comtrade (2016)

A declining demand in several export destination countries is inseparable from the influence of Indonesia's main competitors in the EU market, such as the Philippines, Thailand, Vietnam and China. Based on data on the development of import values over the past 6 years, there has been an increase in the value of canned tuna exports from the Philippines to Italy, the United Kingdom, Spain, the Netherlands and Germany. The country controls the export of canned tuna in the German market with export value of US $ 69,3 million. In contrast, Indonesian exports to this market had continued to decline since 2012 before reached the lowest value of US $ 1,2 million in 2017. Besides the Philippines, Thailand is another competitor. Although there is a downward trend in Italy, Spain and the United Kingdom, the country still becomes a major exporter to the Netherlands. However, since 2015 there has been a decline in the value of Thai exports, which in turn has increased the value of Indonesia's exports in the Netherlands until 2017. This basically indicates an increase in demand for Indonesian canned tuna, even though the value of Thai exports still outperforms Indonesia in Spain, the United Kingdom and Germany. Vietnam is another competitor. Although Vietnam's export value is relatively lower than the other two competitors, there has been an increase in the value of Vietnamese exports in Italy, Spain and the Netherlands. Moreover, the import value of canned tuna from Vietnam has surpassed Indonesia in Germany from 2016 to 2017. Another interesting fact is the emergence of China as a new competitor for canned tuna exports in the EU. The country has even been a major exporter in Spain since 2015 with export value of US $ 47 million, which is above the Philippines, Thailand, Vietnam and Indonesia (Figure 5).

Figure 5. **The development of the export value of Indonesian canned tuna to the EU market from 2006 to 2015**
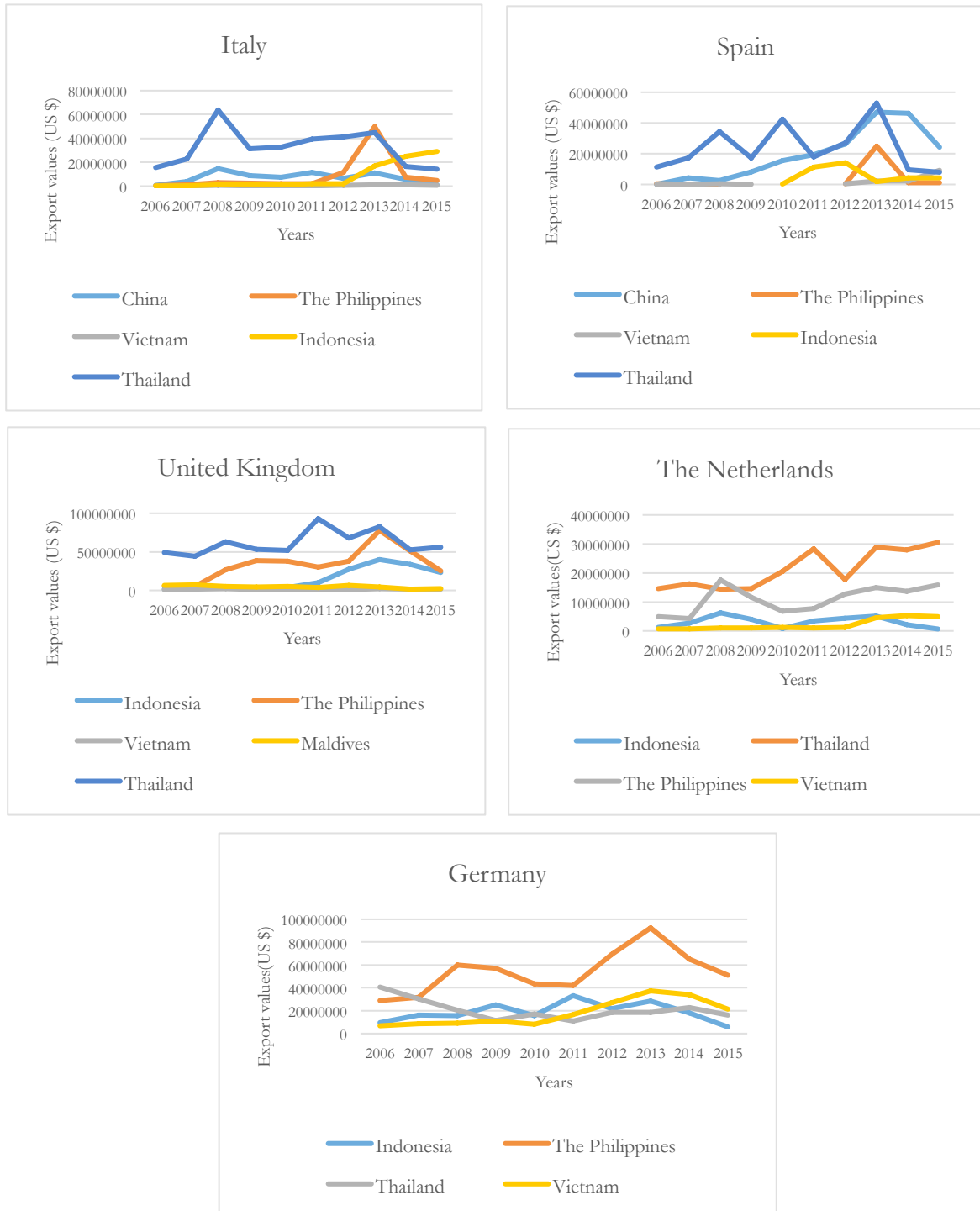
Source: UN Comtrade (2016)

Results of Constant Market Share Analysis (CMSA)

The CSMA calculations in this study were divided into two periods of 2006 to 2010 and 2010 to 2015 in the 10 export destination countries. Indonesian canned tuna exports during 2006 to 2010 in the Netherlands decreased by 40,96 % or US $ 533,051 and the similar decline also occurred in 2010 to 2015 but with a smaller percentage of 22,74 % or US $ 174,697. The decline was caused by a decrease in Indonesian canned tuna competitiveness. The import growth effect decreased by US $3,360. The composition effect had a very high effect during the period 2006 to 2010, but the effect declined over the next 5 years. Indonesian canned tuna exports in Belgium during 2006 to 2010 indicated an increase of US $ 2,233,687 which was influenced by the competitiveness effects, however, in the next five years there was a decline in competitiveness and import growth which contributed to a decline in Indonesian exports by 15,52 % or US $ 383,172. Italy as Indonesia's main destination market indicated an increase in exports during 2006 to 2010 by 399,89 % or US $ 760,415 and 2970,36 % or US $ 28,235,417 during 2010 to 2015. This very drastic increase was caused by an increase in the competitiveness of Indonesian canned tuna in Italy during 2010-2015. The effect of import growth decreased by US $ 3,303,545,171, however the decline in demand did not affect the growth of Indonesian canned tuna exports to this country.

Furthermore, Indonesian canned tuna exports in Germany still experienced an increase from 2006 to 2010 which was affected by an increase in the competitiveness effect. However, during the period of 2010 to 2015, there was a decline in exports of 62,54 % or US $ 9,724,040 due to a decrease in the competitiveness effect of US $ 9,589,963 and a decrease in the import growth effect of US $ 2,334,841,108. In contrast, the composition effect indicated an increase of US $ 7,523,784,423. This condition indicated a decline in demand for Indonesian canned tuna in Germany as well as Indonesia's ability to supply to the country as indicated by a decrease in competitiveness. When compared with Figure 4, Indonesia is currently in the fourth place as an exporter of canned tuna after the Philippines, Vietnam and Thailand. Indonesia was still experiencing high demand in Germany compared to the first 5 years period. The effect can be caused by consumer preferences or the influence of competitor products while the decline in competitiveness can be due to price factors (Athanasoglou et al., 2010) and trade barriers in the form of tariff and non-tariff policies set by Germany (Ichikawa, 1996). One of the trade barriers is the obligation to fulfill traceable standards and eco-labeling.

Indonesia's export growth in Poland has also experienced an increase over the past 10 years. From 2010 to 2015, there was a decline in Indonesian canned tuna competitiveness of US $ 18,644,509, but an increase in composition effects caused Indonesia's export growth to remain positive. Portugal evidenced the import growth effect, which decreased by 1,330,273,027 from 2010 to 2015. However, the effect did not cause a decline in the growth of Indonesian canned tuna exports. In addition, there was an increase in

Indonesian competitiveness of US $ 2,712,044. Demand for canned tuna in Slovenia during the period of 2010 to 2015 has evidenced a decrease in the import growth effect of US $ 7,362,993 and the competitiveness effect of US $ 80,423,130. Although the composition effect gave a positive increase in value of US $ 7,677,912, this situation was not able to increase Indonesia's export growth, which declined by US $ 232,736 during the period of 2006 to 2010 and US $ 82,666 during the period of 2010 to 2015. Spain evidenced the opposite situation where there was a growth in Indonesian canned tuna exports of US $ 259,230 during the period of 2006 to 2010 and US $ 4,194,343 during the period of 2010 to 2015. The state was caused by an increase in the competitiveness effect of US $ 4,202,789,239 and the composition effect of US $ 50,451,510. Despite the overall decline in Spain imports, it turns out that consumer interest and the competitiveness of Indonesian canned tuna are still high. It becomes a positive sign that Indonesia is still able to maintain its market share. Similar condition also occurs in Sweden. Finally, the United Kingdom as the second market for Indonesian canned tuna exports evidenced the competitiveness and composition effect that increased during the period of 2010 to 2015. The effect of competitiveness of Indonesian canned tuna increased by US $ 19,326,921.99 and contributed to the increase in Indonesian canned tuna exports by US $ 19,342,882. The composition effect increased by US $ 1,202,793,351 while the effect of import growth decreased by US $ 3,090,555,740 (Table 2).

Table 2. **Indonesia CSMA results (US $)**

Countries	Periods	Import growth effect	Composition effect	Competitiveness effect	Export growth
Netherlands	2010	6,058.153	1,474,893.784	-536,008.062	-533,051
	2015	-3,360.875	367,059.887	-174,432.780	-174,697
Belgium	2010	498,661.578	13,393.132	2,208,417.222	2,233,687
	2015	-251,551.463	833,943.461	-255,584.140	-383,172
Italy	2010	282,601.1283	12,294.608	741,329.467	760,415
	2015	-3,303,545.171	190,689.254	28,383,865.25	28,235,417
Germany	2010	3,417,805.660	-2,633,549.916	4,249,137	5,780,491
	2015	-2,334,841.108	7,523,784.423	-9,589,963	-9,724,040
Poland	2010	0	66,996.305	183,308,592	234,263
	2015	0	69,643.960	-18,644,509	14,108
Portugal	2010	0	0	0	0
	2015	-1,330,273.027	0	2,712,044	2,712,044
Slovenia	2010	51,702.334	52,039.922	-281,776.786	-232,736
	2015	-7,362.993	7,677.912	-80,423.130	-82,666
Spain	2010	0	0	259,230	259,230
	2015	-580,038.366	50,451.510	4,202,789.239	4,194,343
Sweden	2010	0	-8,212.997	4,332.070	9,516
	2015	-1.115.319	19,351.111	9,974.153	7,178
United Kingdom	2010	417.623.813	-21,495.357	2,209,847.179	2,242,365
	2015	-	1,202,793.351	19,326,921.990	1,9342,882

	3,090,555.740

Source: Author's calculation

Figure 6 indicated that the competitiveness of Indonesian canned tuna during the period of 2010 to 2015 has increased in Italy, Portugal, Spain, Sweden and the United Kingdom. On the contrary, it experienced a very large decline in Germany. The effect of the decline in import growth was quite significant in Italy, Germany, Portugal, the United Kingdom and Spain. This decrease indicated a decline in economic growth and general import demand in these countries which directly affected the demand for Indonesian canned tuna. However, Indonesia was still able to maintain market share in Italy, Portugal, Spain, Sweden and the United Kingdom. The growth of Indonesia's export value still experienced a positive trend in the five countries. The effect of Indonesia's commodity composition in the ten countries indicated a positive trend with the highest values in Germany. This represented the consumer interest and high quality of Indonesian canned tuna.

Figure 6. **Indonesia CMSA results**
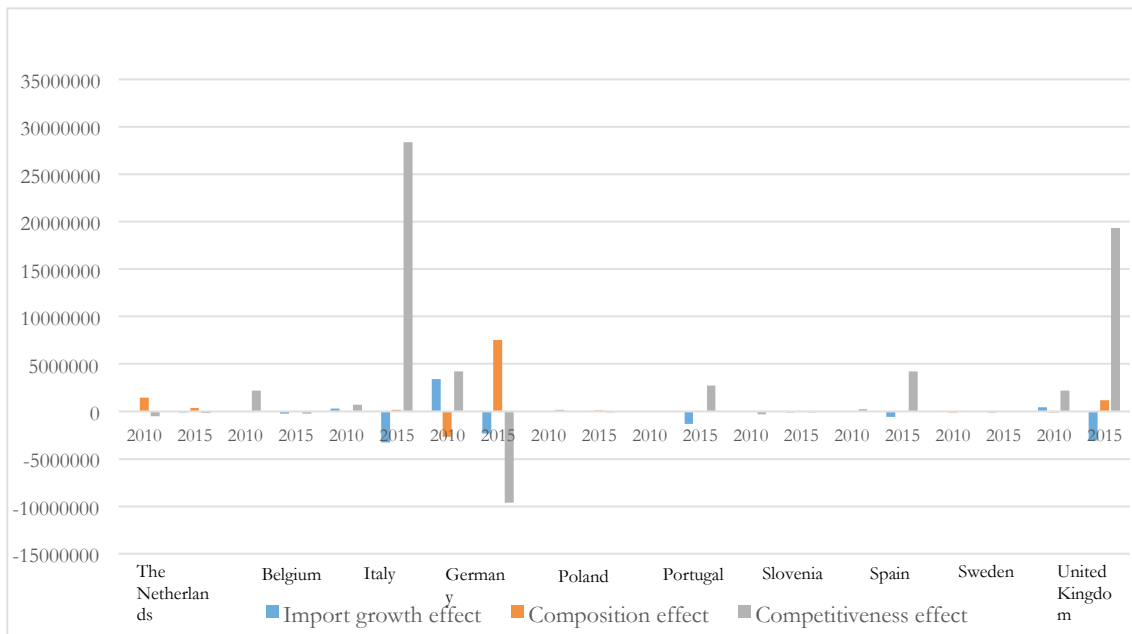
Source: Author's calculation

Generally, the performance of Indonesian canned tuna exports to the EU market is more affected by the effects of competitiveness when compared to the performance of Thai canned tuna exports in figure 6 which is more affected by the import growth and the composition effect. In 2015, the competitiveness effect decreased in Italy, Germany, Portugal, Spain and the United Kingdom. The effect experienced a very large decline during the period of 2006 to 2010 in Germany, however, there was an immoderate decline in the following 5 years. It indicates that Thai canned tuna became more desirable in Germany and the effect of economic growth and German imports have positive effects on imported Thai canned tuna. The highest effect of import growth was evidenced in the United Kingdom during the period of 2010 to 2015. Unsurprisingly, Thailand had the largest export value in the country compared to other competitors (Figure 7).
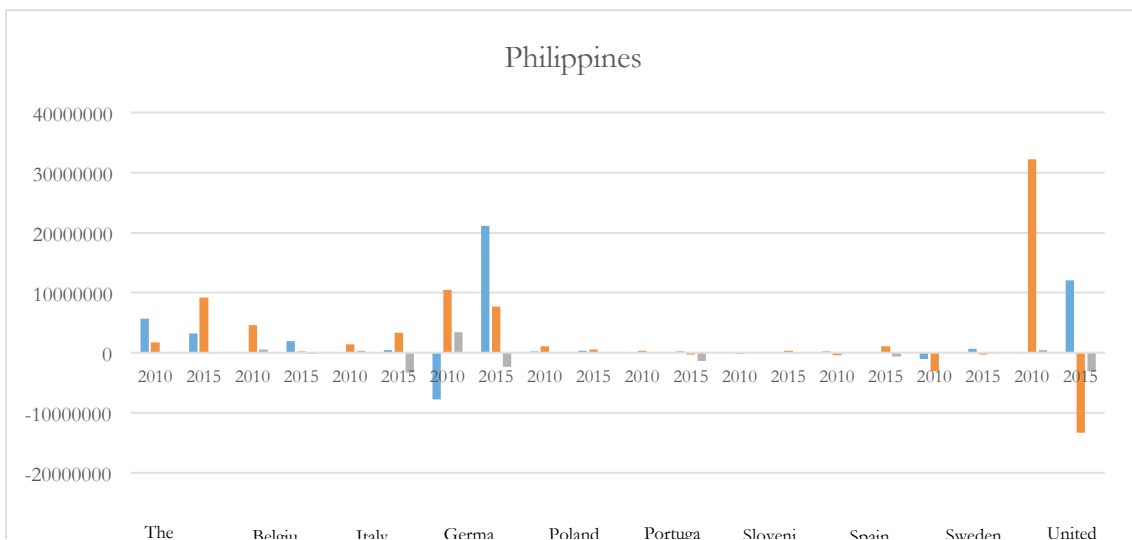
Figure 7. **Thailand CMSA results**
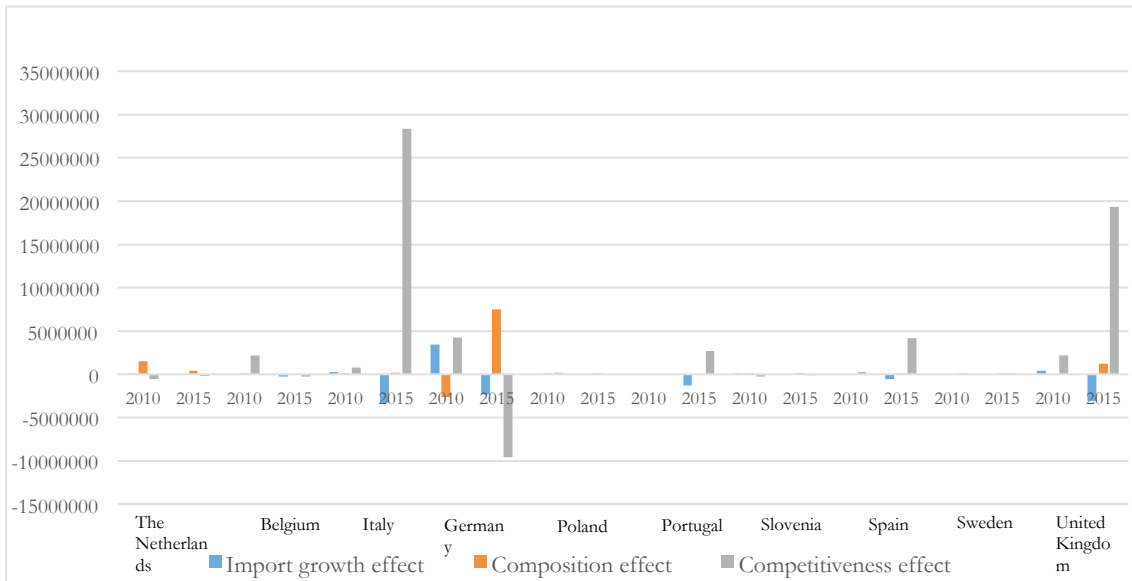
Source: Author's calculation

The Philippines canned tuna exports is more affected by the composition and the competitiveness effects. The Philippines is the main supplier of canned tuna in Germany. Figure 8 indicated that this is as the result of the high composition effect. Practically, the export value of canned tuna from this country increased during the period of 2010 to 2015 in Spain, the Netherlands, Italy, Slovenia and Germany which were affected by the competitiveness effect. Compare to Indonesia, the competitiveness effect declined in the Netherlands, Germany and Slovenia and was very high in Italy and the United Kingdom.

Figure 8. **The Philippines CMSA results**

Source: Author's calculation

Similar to the Philippines, Vietnam's export performance is more affected by the competitiveness and composition effects. The competitiveness effect is very high in Germany and following by Spain. This is in contrast to Indonesia, where there was a huge decline in competitiveness in Germany. Thailand also experienced a similar trend in Germany, but the effect provided was not as high as in Indonesia. The Philippines still has a positive competitiveness effect, but not as high as Vietnam. This has brought both countries to become the main suppliers of canned tuna in Germany during the period of 2010 to 2015. (Figure 9).

Figure 9. **Vietnam CMSA results**
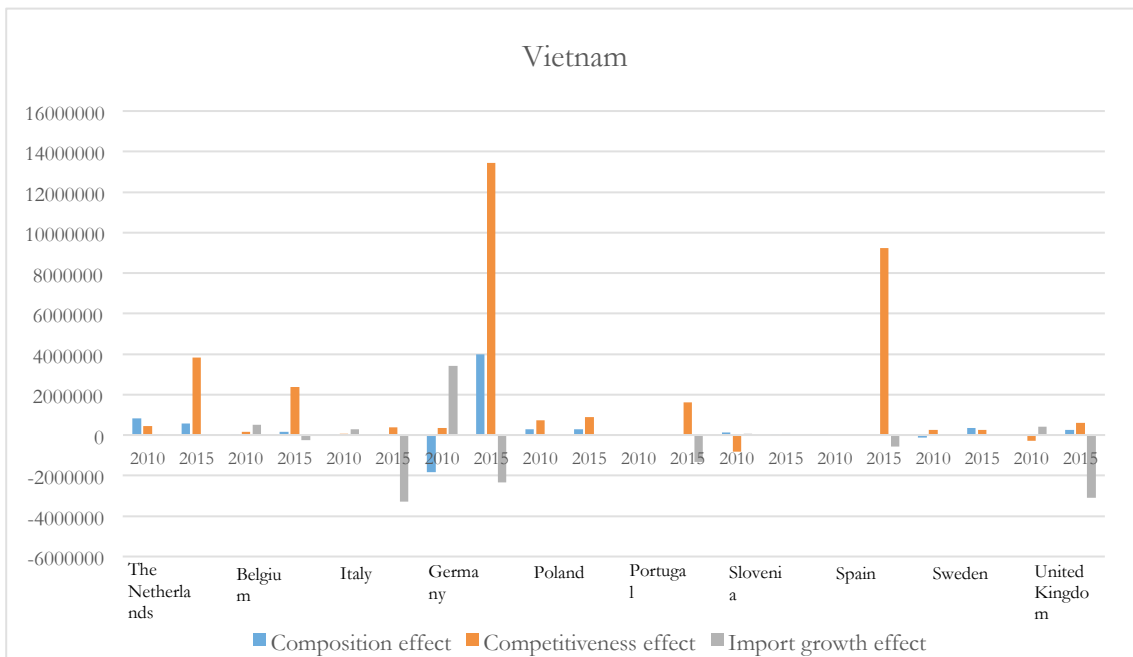
Source: Author's calculation

Determinants of Indonesian canned tuna exports

Table 3 indicated the results of PPML regression of independent variables of GDP of importing countries, real exchange rates, Indonesian tuna production volumes, economic distances, and population of importing countries on the dependent variable of Indonesian canned tuna export volumes from 2006 to 2015. We followed the assumptions of PPML regressions as suggested by Silva & Tenreyno (2006) that PPML estimator does not require assumptions of normality and multicollinearity. A problem of heterocedasticity has been assumed to be overcome by the selection of the PPML itself.

Table 3. **PPML estimation results**

Variables	Coefficients	P-Values
Ln GDP	0.372	0.878
Ln Real exchange rate	-1.377	0.088*
Ln Production	4.669	0.000***
Ln Economic distance	0.358	0.753
Ln Population	31.138	0.000***
Constant	-562.6804	0.000***
Number of observations	100	
R-Square	0.819	

*, **, ***: Significant at α 10%, 5%, 1%

Source: Author's calculation

Factors that significantly affect the export of Indonesian canned tuna to the EU are population of importing countries, Indonesian tuna production volumes and real exchange rates. The relatively large population coefficient (31,138) indicated the large impact of the variable on the demand for Indonesian canned tuna. An increase of 1 % of the population in export destination countries is estimated to be able to increase 31,138 tons of the volume of exports to export destination countries, ceteris paribus. These results are in accordance with the prior empirical applications by Zarzoso & Lehmann (2003), and Elshehawy, Shen, & Ahmed, (2014) where export destination countries with large populations will import more than countries with small populations. With this assumption, because the EU is the largest market for Indonesian canned tuna, the effect provided will also be very significant. Some other studies state that the impact of the population cannot be determined deductively. This is because the population of the importing country can have a positive effect or otherwise for exports in the small countries. The argument was explained by Armstrong (2007), Zarzoso & Lehmann (2003), and Jordaan (2015). The positive effect and magnitude of the coefficient obtained in this study can be considered as a signal of low self-sufficiency in EU countries and they are very dependent on imported canned tuna from Indonesia. Moreover, figure 10 indicated an increase in the total population of the EU accompanied by an increase in imports of canned tuna from Indonesia. The average growth of the EU population over the past 10 years was 0,259 %, while the average growth volume of imports of Indonesian canned tuna during this period was 12,510 % with an average import value of US $ 51,1 million. The growth in demand for Indonesian canned tuna is much higher than the population growth in the EU. This indicates a very positive opportunity for the development of domestic canned tuna industry.

Figure 10. **The development of the EU population and import of Indonesian canned tuna**
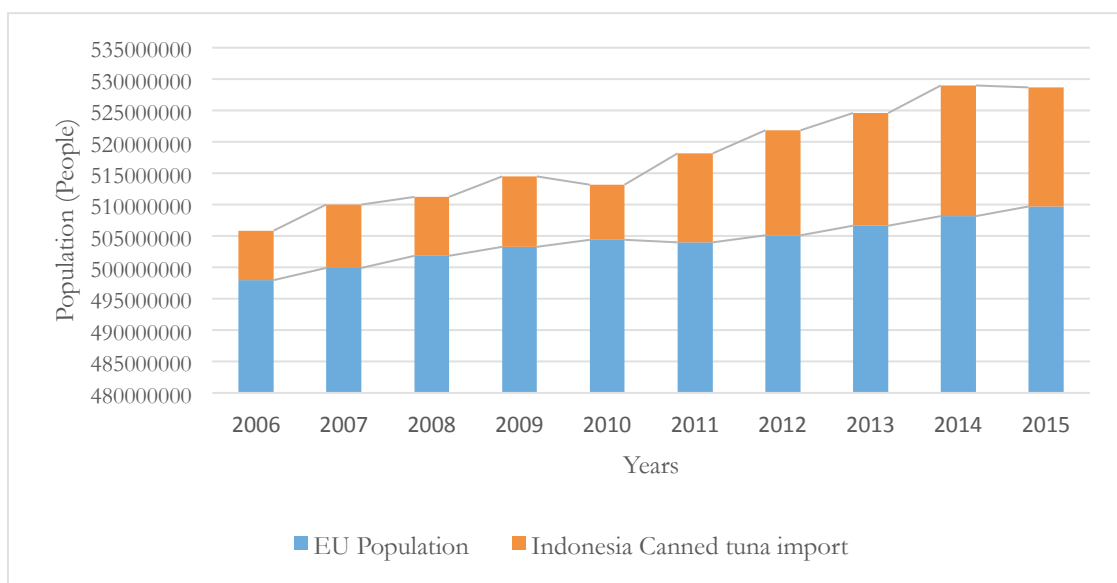
Source: World Bank (2017) and UN Comtrade (2016)

In addition to the population, a 1 % increase in Indonesian tuna production volumes is estimated to be able to increase 4,669 tons of export volume, ceteris paribus. This result supports the prior empirical applications by Hidayati & Masyhuri (2015) and Zakariya, Musadieq, & Sulasmiyati (2016) which state that the tuna production volume will affect the volume of tuna supply in the international market. Figure 11 indicated the volume of Indonesian tuna production has increased over the past 10 years and it is followed by an increase in the overall export volume of tuna and canned tuna. The high production indicated that Indonesia's potential for tuna is very high which will provide a high profit if it is able to be marketed optimally. However, things such as sustainable practices in the post-harvest process should take a very important attention. The western world as a major importer country begin to implement special policies regarding tuna imported from the aspects of sustainability and environmental impacts through eco-labeling and private certifications. Indonesia's inability to respond to downstream policies will affect demand for Indonesian tuna in the future. Moreover, several exporting countries in the Asia Pacific region have produced seafood products with the Marine Stewardship Council (MSC) certification while until 2018 Indonesia has not been able to obtain an MSC certification for all seafood products.

Figure 11. **The comparison of Indonesian tuna production and exports from 2006 to 2015**
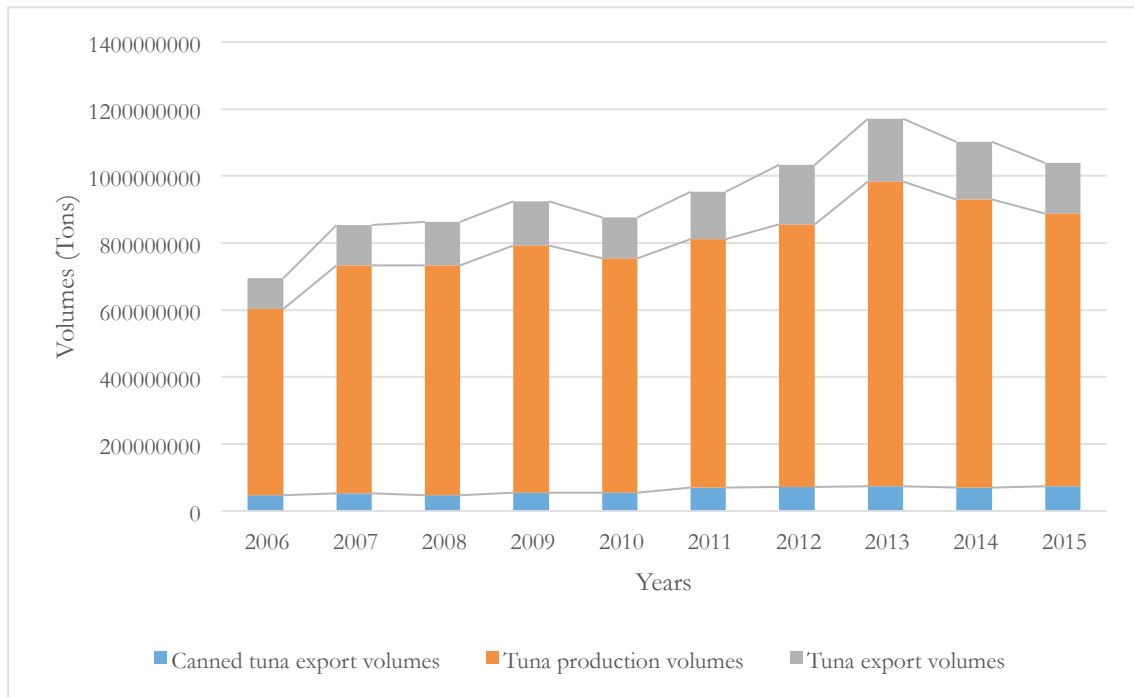
Source: FAO (2016) and UN Comtrade (2016)

The last factor affecting Indonesia's tuna exports to the EU is real exchange rates. Strengthening the real exchange rate of the rupiah against the US dollar by 1 Rp/US$, will reduce 1.377 tons of the Indonesian tuna exports to the EU market, ceteris paribus. Theoretically, according to the Mundell-Flemming model, net export is a negative function of the real exchange rate when the exchange rate is calculated using the indirect measurement method of US $/Rp. Conversely, when the exchange rate is calculated using the direct term measurement method of Rp/US $, the increase in the real exchange rate is seen as a depreciation in the exchange rate of the Rupiah against the US $ which will reduce export competitiveness and increase imports. A decline in the real exchange rate will increase imports from importing countries (Zuhroh & Kaluge, 2007). In this study, the real exchange rate is calculated using a direct term approach so that the increase in the real exchange rate will reduce the export volume of Indonesian tuna to the EU market. This supports the results of prior studies on Indonesian export commodities by Pradipta & Firdaus (2015), Kusuma & Firdaus (2015), Lembang & Pratomo (2017), Saptanto &

Soetjitpto (2017). Overall, the ability of the variables in the model in explaining the dependent variable is 81.9 %.

Conclusion

The CMSA results indicated that the growth of Indonesian canned tuna exports to the EU market is highly affected by the competitiveness effect. During the period of 2010 to 2015, Indonesian canned tuna competitiveness has increased in Italy, Portugal, Spain, Sweden and the United Kingdom, but it experienced a very high decline in Germany. In contrast, import growth has experienced a significant decline in Italy, Germany, Portugal, the United Kingdom and Spain. However, Indonesia was still able to maintain market share in Italy, Portugal, Spain, Sweden and the United Kingdom. When compared with the three competitors, the growth of Thai canned tuna exports was strongly affected by the import growth and composition effects while the Philippines and Vietnam were strongly affected by the composition and competitiveness effects.

Furthermore, the results of the PPML regression indicated that the factors that significantly affect the export of Indonesian canned tuna to the EU are the population of importing countries, Indonesian tuna production volumes and real exchange rates. This study only involves non-price variables, therefore for further research it is recommended to include price variables. In addition, the scope of this research is limited to the EU market. It is recommended for further research to analyze the USA and Japan markets.

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