TRADE FLOWS ANALYSIS AND THE ROLE OF STANDARDS ON CANNED TUNA TRADE

KHAIRUNIKA NUR RAHMAH

GRADUATE SCHOOL
BOGOR AGRICULTURAL UNIVERSITY

BOGOR
2016
I hereby declare that thesis titled Trade Flows Analysis and the Role of Standards on Canned Tuna Trade, was independently composed by me under the advisory committee supervision and has not been submitted to any other universities. Source of information derived or quoted from works published and unpublished from other writers have been mentioned in the text and listed in the references at the end of this thesis.

I hereby assign the copyright of my thesis to the Bogor Agricultural University.

Bogor, April 2016

Khairunnisa Nur Rahmah
H351120201
KHAIRUNISA NUR RAHMAH. Trade Flows Analysis and the Role of Standards on Canned Tuna Trade. Supervised by ANDRIYONO KILAT ADHI, DWI RACHMINA and BERNHARD BRÜMMER.

Tuna is one of the most important commodities traded in the world fish industry. International trade of tuna is mainly taking form in canned tuna. Like other traded goods, canned tuna trade can potentially be hindered by international trade rules. The presence of trade barriers can affect the trade flow of tuna by affecting its price and availability in specific regions. Trade barriers in tuna trade are including: tariff measures, non-tariff measures and different standards imposed across countries. This study analyzes trade flows and the role of standards on the international canned tuna trade from three largest exporters in Asia: Thailand, the Philippines and Indonesia. The study used annual export value of tuna from Thailand, the Philippines and Indonesia to 50 export destinations for 14 years, 2000 to 2013. In the data set, accounted 21 percent of the trade data were zero trade observations.

The gravity model with Ordinary Least Squares (OLS) and Poisson Pseudo Maximum Likelihood (PPML) estimation with fixed effect are utilized to determine factors affecting trade flows of canned tuna and whether standards act as barriers to canned tuna trade from Thailand, the Philippines and Indonesia. The regression results from both estimations then compared. Variables included in the model are canned tuna production from each exporter, Gross Domestic Product (GDP) of importing countries, remoteness, exchange rate, participation in free trade agreements (FTAs) and standards. Standards are captured by dummy variables which categorized on how strict export destination established its standards. Three standards were obtained: (1) if a country imposed national standards; (2) if a country established more restrictive standards; and (3) if a country required not only national standards but also specific certification.

As a result, based on the magnitude of the coefficient, the economic implications and the explanatory ability of the model, the PPML estimation provides a better approach to quantifying the changes in canned tuna trade flows. The regression result shows that factors that significantly affecting the canned tuna export are the canned tuna production, GDP of importing countries, exchange rate, participation in FTAs and standards. Canned tuna production, GDP of importing countries and participation in FTAs showed positive impact to canned tuna trade. All standards variables have a negative and significant impact on canned tuna trade, which means the imposition of stricter standards hinder trade by reducing canned tuna export from Thailand, the Philippines and Indonesia. The imposition of standards by the foreign countries is likely to stricter due to growing concern of health and environmental awareness for better-off consumers. It implies that Thailand, the Philippines and Indonesia have to prepare to comply with this requirement by increasing its national standards to improve market access.

Key words: canned tuna, gravity model, poisson pseudo maximum likelihood, standards
Bogor Agricultural Institute

Hak Cipta Milik IPB (Institut Pertanian Bogor)
RINGKASAN

KHAIRUNNISA NUR RAHMAH. Analisis Aliran Perdagangan dan Peran Standar dalam Perdagangan Tuna Kaleng. Dibimbing oleh: ANDRIYONO KILAT ADHI, DWI RACHMINA dan BERNHARD BRÜMMER.


Metode analisis yang digunakan untuk mengetahui aliran perdagangan dan peran standar dalam perdagangan tuna kaleng dari Thailand, Filipina dan Indonesia, yaitu model gravitasi melalui pendekatan metode kuadrat terkecil dan Poisson Pseudo Maximum Likelihood (PPML), dengan menggunakan efek tetap. Kedua pendekatan kemudian dibandingkan untuk diteliti lebih lanjut. Variabel yang digunakan dalam model diantaranya produksi tuna kaleng, pendapatan domestic bruto (PDB), jarak, nilai tukar, partisipasi dalam kesepakatan perdagangan dan standar. Standar ditangkap dengan variabel dummy yang dikelasifikasi berdasarkan keketatannya penetapan standar dalam negara tujuan. Terdapat tiga kategori standar, dimana: (1) jika negara menerapkan standar nasional; (2) jika negara menerapkan standar yang lebih kompleks; dan (3) jika negara tidak hanya menerapkan standar nasional tapi juga menyertakan sertifikasi khusus sebagai suatu persyaratan untuk memasuki negara tersebut.


Kata kunci: model gravitasi, poisson pseudo maximum likelihood, standar pangan, tuna kaleng
It is prohibited to quote part or all of this paper without including or citing the source. Quotations are only for purposes of education, research, scientific writing, preparation of reports, critics, or review an issue; and those are not detrimental to the interest of the Bogor Agricultural University.

It is prohibited to announce and reproduce part or all of this paper in any form without the permission of the Bogor Agricultural University.
TRADE FLOWS ANALYSIS AND THE ROLE OF STANDARDS ON CANNED TUNA TRADE

KHAIRUNNISA NUR RAHMAH

Master Thesis
as one of requirements to obtain a degree of
Master Science
in
an Agribusiness Study Program

GRADUATE SCHOOL
BOGOR AGRICULTURAL UNIVERSITY
BOGOR
2016
External Examiners Commission : Dr Ir Suharno, M.Adev
Examiners Program : Prof Dr Ir Rita Nuralina, MS
Thesis Title: Trade Flows Analysis and the Role of Standards on Canned Tuna Trade
Name: Khairunnisa Nur Rahmah
NRP: H351120201

Approved by
Advisory Committee
Dr Ir Antrivono Kilat Adhi
Chairman
Dr Ir Dwi Rachmina, MSi
Member
Prof Dr Bernhard Brümmer
Member

Agreed by
Head of Agribusiness Study Program
Prof Dr Ir Rita Nurmalina, MS

Dean of Graduate School
Dr Ir Dahruh Syah, MScAgr

Examination Date: February 4, 2016
Submission Date: 20 APR 2016
Hak Cipta Ditundang: Lindong-Lindong

1. Dilengkapi menggunakan alat seluruh korpa lulus ini, menandatangani dokumen ini.
2. Pengujian hak merujuk keputusan Yang Wajar.

Bogor Agricultural Institute
Hak Cipta Miller IPB (Institut Pertanian Bogor)
ACKNOWLEDGMENT

All praise is due to Allah, the lords of the world, the beneficent, the merciful, for his blessing on everything in my life. This research would have been impossible without the support from many people. I would like to appreciate everyone who encouraged me.

I would like to express my gratitude to the supervisory committee, Dr. Ir. Andriyono Kilat Adhi who supports me academically in thesis writing from the beginning until the last step. It is a pleasure to acknowledge the support and help from my second supervisor Dr. Ir. Dwi Rachmina, MSi. I am grateful to the examiner of this thesis, Dr. Ir. Suharno, M.Adev for his critiques and advices which richen this study. I would like to to express gratitude to the Head of Agribusiness Study Program, Bogor Agricultural University, Prof. Dr. Ir. Rita Nurmalina, MS for her advices. I would also like to thank my supervisors from Georg-August Göttingen University Germany, Prof. Dr. Bernhard Brümmer and Prof. Dr. Stephan von Cramon Taubadel for their support and assistance in this research. I am grateful to the Faculty of Agricultural Sciences of the Georg-August Göttingen University, especially Frau Thinggaard for all support. I would like to express my gratitude to the Indonesia-Germany Joint Degree Scholarship program from Beasiswa Pendidikan Pascasarjana Luar Negeri (BPPLN) Directorate General of Higher Education and Beasiswa Unggulan - Biro Perencanaan dan Kerjasama Luar Negeri, the Ministry of National Education Republic of Indonesia for funding my study.

I am also grateful to my beloved family: my husband, my lovely parents, my dearest sister and my grandparents, who always encourage, support and love me unconditionally. To them I dedicated this thesis.

Last but not least, I would like to thank all friends and new family I met both in Bogor and in Göttingen. My special thanks go to The Intan, Dhea, Maika, Irfan, Mbak Wida, Rizah, Asih, Liza, Afni and everybody else who help and support me throughout my master study.

Bogor, April 2016

Khairunnisa Nur Rahmah
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTENTS</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xi</td>
</tr>
</tbody>
</table>

## 1 INTRODUCTION
- Background 1
- Problem Statement 3
- Research Objectives 4
- Benefits of the Study 4
- Scope and Limitation of the study 4

## 2 LITERATURE REVIEW
- Gravity Model Approach in Trade Flow Analysis 5
- Variables Construct Gravity Model 5
- Definition of Standards and Motivation for Developing Standards 7
- Food Safety Standards and Seafood Trade 8

## 3 FRAMEWORK
- The International Trade Theories 9
- Barriers on Trade 11
- Trade Flow Analysis Using Gravity Model Approach 13
- The Exchange Rate and Trade 15
- Operational Framework 16

## 4 RESEARCH METHODOLOGY
- Types and Sources of Data 17
- Panel Data Analysis Using Gravity Model 18
  - Ordinary Least Square (OLS) 18
  - Poisson Pseudo Maximum Likelihood Estimation 20
- Model Formulation of Canned Tuna Trade 20
- Hypotheses Testing and Goodness of Fit 21

## 5 GENERAL OVERVIEW OF CANNED TUNA INDUSTRY
- Description and History of Canned Tuna 23
- Development of Canned Tuna Industry in Thailand, the Philippines and Indonesia 24
  - Thailand 24
  - The Philippines 26
  - Indonesia 27

## 6 RESULTS
- Trade Flows of Canned Tuna 29
- Standards on Fish and Fishery Trade 30
- Factors Affecting Trade Flows of Canned Tuna 33
- Comparison of OLS and PPML Result 36
- Interpretation of the PPML Estimation of Canned Tuna Trade 38
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Recommendations
LIST OF TABLES

1  Data Sources 18
2  The Dummy Categories of Standards 19
3  Overview of Major Tuna Processors in Thailand, 2010 25
4  Overview of Major Tuna Processors in the Philippines, 2010 26
5  Overview of Major Tuna Processors in Indonesia, 2010 28
6  List of Standards Imposed by Importing Countries 31
7  Summary and Descriptive Statistics 33
8  OLS and PPML Estimation Results 37
9  The Change in Canned Tuna Exports due to Establishment of Standards and FTAs 41

LIST OF FIGURES

1  Fish and fishery export by region, 2000-2011 1
2  Canned tuna exports by region, 2011 2
3  Canned tuna exports by Asian countries in thousand MT, 1976-2011 2
4  International trade 10
5  The economic effect of trade barriers 12
6  The impact of exporter currency appreciation on trade 15
7  Operational framework 16
8  Worldwide catches of commercial tuna, 1950-2012 22
9  Thailand, the Philippines and Indonesia canned tuna production, 1976-2011 24
10  Thailand, the Philippines and Indonesia canned tuna export performance by value, 1996-2013 29
11  World canned tuna importers by value, 2012 29
12  Canned tuna importers for each exporter by value, 2012 30
13  The export value (US$) of Thailand, the Philippines and Indonesia canned tuna, 2000-2013 34
14  The tuna production (MT) of Thailand, the Philippines and Indonesia, 2000-2013 35
15  The exchange rate of Thailand, the Philippines and Indonesia in US$, 2000-2013 35
16  The development of standards imposed by importing countries, 2000-2013 36
17  The average export value (Million US$) and production (thousand MT) of Thailand, the Philippines and Indonesia canned tuna, 2000-2013 39
18  GDP of main export destination countries, 2000-2013 40

LIST OF APPENDICES

1  List of Exporting and Importing Countries 51
2  Hausman test result 51
3  The result of basic assumption testing 52
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIC</td>
<td>the Asia Regional Integration Center</td>
</tr>
<tr>
<td>AvW</td>
<td>Anderson and van Wincoop</td>
</tr>
<tr>
<td>CAC</td>
<td>the Codex Alimentarius Commission</td>
</tr>
<tr>
<td>CFIA</td>
<td>the Canadian Food Inspection Agency</td>
</tr>
<tr>
<td>CEPII</td>
<td>the Centre d'Etudes Prospectives et d'Informations Internationales</td>
</tr>
<tr>
<td>CES</td>
<td>Constant Elasticity Substitution</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EEZ</td>
<td>Economic Exclusive Zone</td>
</tr>
<tr>
<td>EU</td>
<td>The European Union</td>
</tr>
<tr>
<td>FAQ</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>FEM</td>
<td>Fixed Effect Model</td>
</tr>
<tr>
<td>FMA</td>
<td>Fishery Management Area</td>
</tr>
<tr>
<td>FTA</td>
<td>Free Trade Agreement</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>HACCP</td>
<td>Hazard Analysis of Critical Control Point</td>
</tr>
<tr>
<td>HO</td>
<td>Heckscher-Olin</td>
</tr>
<tr>
<td>HS</td>
<td>Harmonized System</td>
</tr>
<tr>
<td>IUU</td>
<td>Illegal, Unreported and Unregulated</td>
</tr>
<tr>
<td>MMAF</td>
<td>Ministry of Marine Affairs and Fisheries</td>
</tr>
<tr>
<td>MRL</td>
<td>Maximum Residual Limit</td>
</tr>
<tr>
<td>MT</td>
<td>Metrics Ton</td>
</tr>
<tr>
<td>NTT</td>
<td>New Trade Theory</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization of Economic Cooperation and Development</td>
</tr>
<tr>
<td>OLS</td>
<td>Ordinary Least Squared</td>
</tr>
<tr>
<td>PPML</td>
<td>Poisson Pseudo Maximum Likelihood</td>
</tr>
<tr>
<td>REM</td>
<td>Random Effect Model</td>
</tr>
<tr>
<td>SEAFDEC</td>
<td>the Southeast Asian Fisheries Development Center</td>
</tr>
<tr>
<td>SPS</td>
<td>Sanitary and Phytosanitary</td>
</tr>
<tr>
<td>TBT</td>
<td>Technical Barriers to Trade</td>
</tr>
<tr>
<td>UNCOMTRADE</td>
<td>the United Nations Commodity and Trade</td>
</tr>
<tr>
<td>US</td>
<td>The United States</td>
</tr>
<tr>
<td>USDA</td>
<td>the United States Department of Agriculture</td>
</tr>
<tr>
<td>WCPO</td>
<td>Western and Central Pacific Ocean</td>
</tr>
<tr>
<td>WTO</td>
<td>World Trade Organization</td>
</tr>
</tbody>
</table>
Hak Cipta Dilihat Sebagai Lindung-Lindung

Hak Cipta Milik IPB (Institut Pertanian Bogor)
1 INTRODUCTION

Background

Fish and fishery products have long been traded internationally. Over the last several decades, trade in the fish industry products has grown tremendously by 121 percent worldwide, with export values increasing from US$58.2 billion in 2002 to US$129.1 billion in 2012. Asia, among other regions, has had a significant role in fish and fishery trade by contributing US$50 billion, or 39 percent, to the total export in value in 2011 alone (Figure 1). The fisheries sector has also provided substantial employment opportunities to the world’s population. By 2012, 10 to 12 percent of people’s livelihoods depended on this sector globally, with 84 percent of people in Asia being employed within the sector (FAO 2012).

Figure 1 Fish and fishery export by region, 2000-2011
Source: Author’s elaboration with data from FAO FishstatJ (2015)

Tuna is the third of most important commodity traded in the fish industry. Tuna trade reached US$ 6.2 billion and accounted for 8.7 percent of the total value of the fish trade in 2004. Tuna consumption is popular worldwide because it is relatively low in calories, low in fat, high in protein and high in Omega-3. Moreover, tuna has also been marketed as a canned product, which not only offers its standard advantages, but is also convenient for being added to other foods for an increased usefulness. In 2005, nearly 82 percent of the world tuna supply was consumed as a canned product rather than fresh (Gilman 2009). Thus, a high demand for canned tuna encourages tuna producing countries to produce tuna as a canned variety.

International trade of canned tuna was dominated by the Asian market with 61 percent of total net weight of exports in 2011, accounting for 1.30 million MT (Figure 2). Thailand, the Philippines and Indonesia are the three largest canned tuna exporters in Asia. In 2012, Thailand alone accounted for around 560
million MT, or 45 percent of total canned tuna traded globally; a figure which is almost 4 times larger than any other exporters. Meanwhile, the Philippines and Indonesia contributed 8 percent and 6 percent in net weight, respectively.

Figure 2 Canned tuna exports by region, 2011
Source: Author’s elaboration with data from FAO FishstatJ (2015)

The time trend in exports (Figure 3) reveals that Thailand, the Philippines and Indonesia experienced a rapid growth in exporting canned tuna from the beginning of 1980’s to 2000. The average growth rate of canned tuna exports during this period was highest in Indonesia at roughly 29.8 percent, followed by Thailand (21.9 percent) and the Philippines (14 percent). According to the United Nations Commodity Trade Statistics Database (2013), canned tuna from Thailand, the Philippines and Indonesia was dispersed globally with more than 100 countries listed as export destinations.

Figure 3 Canned tuna exports by Asian countries in thousand MT, 1976-2011
Source: Author’s elaboration with data from FAO FishstatJ (2015)
Problem Statement

The canned tuna trade, however, can potentially be hindered by international trade rules. The presence of trade barriers can affect the trade flow of tuna by affecting its price and availability in specific regions. Several trade barriers in the fish trade are addressed by the Organization of Economic Cooperation and Development (OECD) Committee on Fisheries, primary topics include: tariff measures, non-tariff measures (quotas restriction, anti-dumping policies), government financial transfers and different standards imposed across countries (Hannesson 2001).

Ensuring that different standards requirements met in the target market are becoming the main challenge for exporting fish and fishery products in the last decades (Ababouchi et al 2005). The World Trade Organization (WTO) through the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) and the Agreement on Technical Barriers to Trade (TBT), have given more concise guidance with respect to international trade. The aim of these agreements is to restrict the use of standard requirements that are stipulated in globally traded goods as non-tariff barriers (Grote and Kirchhoff 2001; Bostock et al 2004). To avoid the use of standards as a non-tariff barrier, the WTO has suggested defined international standards such as The Codex Alimentarius as a global reference. Nevertheless, the WTO allows its members to impose their own standards as a precautionary policy, as long as they are based on scientific evidence, limit trade restrictions and are not discriminatory. There are various reasons behind an importing country’s imposition of food safety and quality requirements, including the development of technology in the food industry, growing consumer awareness, and an increased demand for safe, high quality and sustainable foods (Ababouchi et al 2005).

In the canned tuna trade, there are several requirements imposed by importing countries with the intention of protecting consumer health and the sustainability of fishery resources. It is known that tuna and other marine animals are exposed to and accumulate residue and heavy metal contaminants, such as cadmium, mercury, arsenic and lead, which are extremely toxic to humans (Khansari et al 2005). Taking into consideration the demand for safe and healthy food, several countries have established its maximum residual limits for chemical contaminants and drug residues. Furthermore, increasing concerns regarding environmental and sustainable fishing have led some countries to establish mandatory regulation and standards requirements, such as traceability and dolphin safe label. Based on the description above, the research questions for this study are:

1. What factors affect the trade flow of canned tuna from Thailand, the Philippines and Indonesia?
2. Do standards act as a barrier to the canned tuna trade flow from Thailand, the Philippines and Indonesia?
Research Objectives

According to the aforementioned problem statement, the objectives of this study are:
1. To determine factors that may affect the trade flow of canned tuna from Thailand, the Philippines and Indonesia.
2. To analyze whether standards act as a barrier to canned tuna exports from Thailand, the Philippines and Indonesia.

Benefits of the Study

The benefits of this study are:
1. As an information in order to improve export performance of canned tuna industry.
2. As a reference and consideration in setting policy related to canned tuna industry, particularly in terms of increasing standards regulation in importing countries.
3. As a reference and information for further study in more depth approach or different production technology for academics and researchers.

Scope and Limitation of the study

This research was using secondary data that consist of annual canned tuna export from Thailand, the Philippines and Indonesia to 50 importing countries for 14 years, 2000 to 2013. The following limitations are to be considered with this research:
1. The type of tuna used in this research is tunas, skipjack, bonito prepared/preserved, not minced in accordance with the harmonized system (HS) 1996 code 160414.
2. Standards imply any regulation relating to chemical contaminants, drug residues and mandatory certifications in the tuna sector.

2 LITERATURE REVIEW

This chapter incorporates previous studies about the use of the gravity model in trade flow analysis and variables constructing gravity model, definition of standards and motivation in developing standards, reviews concerning international trade rules (regulation) related to food safety standards and its effect on seafood trade respectively.
Gravity Model Approach in Trade Flow Analysis

Gravity models have long been used in explaining bilateral trade. This model itself is based on Newton’s law of gravity, where the predicted trade volume between two countries increases with the size of the economy (GDP) and decreases with the cost of transportation as measured from the economic distance between trading partners (Yamarik and Ghosh 2005). The use of this model in bilateral trade analysis is quite popular for several reasons.

First, the gravity model has proven quite successful in predicting bilateral trade flows and giving consistent results (Kepaptsoglou et al 2010). In the traditional gravity model, many studies from the literature have shown that countries with a larger economic size trades more and countries that have a great distance from one another trade less as a result of higher transportation costs.

Second, many researchers are interested in developing gravity models with respect to theoretical justification and estimating techniques. Even though excellent in determining trade flow patterns, the traditional gravity model has been criticized for not being able to provide strong theoretical foundation. Anderson (1979) was the first who derived the gravity model from economic theory with the assumption of each country specializing in the production of one good. Other alternative theoretical foundations of the gravity model are suggested by Bergstrand (1990) with the employed factorial model, Deardoff (1998) with the Heckser-Ohlin model approach, and Anders and van Wincoop (2003) who followed Anderson’s assumptions and also take into account multilateral resistance terms as a proxy for unobserved trade barriers of trading countries; etc. As the theoretical justification has been developed, other studies shifted their interest in choosing the best technique for estimating the gravity model. Santos Silva and Tenreyro (2006), for example, suggested using Pseudo Poisson Maximum Likelihood (PPML) instead of using OLS methods which converted the multiplicative form of gravity estimation into logarithms. By taking logarithm, the presence of zero observations, that is likely to occur on trade data, is not taken into consideration in OLS estimation. He argued that by reducing or eliminating the zero trade value, a biased estimation would likely occur.

Third, there has been increasing interest in empirically testing the trade effects of related policies (participation in trade agreement/imposing standards on specific commodities) in international trade. Most topics of interest in recent studies refer to whether the policy implementation is actually creating or diverting trade (Kepaptsoglou et al 2010).

Variables Construct Gravity Model

The gravity model of trade flows frequently uses export and bilateral trade flows as dependent variables, while independent variables can be categorized into two groups: factors that represent the supply and demand of trading nations, and factors inhibiting trade flow between countries (Kien 2009; Kepaptsoglou et al 2010). Several variables which are commonly used in the gravity model can be described as follows:
Gross Domestic Product (GDP) and Total Production

GDP is a measure that is used to portray a country’s economic state by showing the production capacity of all available goods and services in that country over a specific period of time. GDP plays a substantial role in the estimation of the gravity model, since it acts as an indicator of a country’s supply and demand (Tinbergen 1962). For the importing country, GDP portrays the purchasing power and the market size or absorptive capacity of the country. As for the exporting country, GDP typically represents the potential capacity for exports (Chen et al 2008). In the case of single or specific commodity trade, instead of using GDP, the commodity’s output (total production) is more appropriate for capturing the effect of the supply side on the export of a commodity (Evans 2001; Hillberry 2002; Chen et al 2008; Pujiati 2014; Sudiyana 2014).

The present study uses the GDP of importing countries and the total canned tuna production for exporting countries to represent supply and demand. These variables are expected to have a positive effect on canned tuna exports.

Distance and Remoteness

Distance between trading countries is commonly used as the main resistance factor in the gravity model. This variable indicates transportation costs faced by trading countries (Salvatore 1997). Typically, distance is calculated by the geographical measure between the countries’ two economic centers. The study of transportation cost on trade flows by Martinez-Zarzoso and Suarez-Burgue (2005) showed that distance and poor infrastructure increase transportation costs. As countries become further apart, transportation cost becomes higher, resulting to a decrease in trade volume. Some studies, however, use economic distance rather than geographical distance. Economic distance is calculated by multiplying the distance between the countries with respect to world oil prices (Meiri 2013).

In the present study, remoteness is used as a measure of hindrance rather than distance. Remoteness not only takes into account how far a country is from others, but also the level of economy activities in each country (Ewing and Battersby 2003). Remoteness can be used as a proxy for multilateral trade resistance which is a bilateral trade resistance term of each country (Herrera 2010). Calculation of remoteness can be written as follows:

\[
Re_{ij} = \sum \frac{d_{ij}}{GDP_i / GDP_w} \]

wheredij denotes the bilateral distance between countries i and j, weighted by the share of each country’s GDP share with respect to world GDP.

Exchange Rate

Exchange rate is the price that a country pays for trading with another country. The volatility of exchange rates between trading countries over time are expected to affect trade flows (Rose 2000 in Kepaptsoglou et al 2010). Several studies have been conducted in attempt to explain the relationship between international trade and the exchange rate. The main discussion is that an increasing in the exchange rate volatility led to a lower international trade. This condition occurs because variability in the exchange rate is associated by risks and transaction cost in which reduce the incentives to trade. As a result, risk-averse
agents reduce their international trade activity and shift their production into the domestic market (Dell 1998). In addition, Broda and Romalis (2010) in Nicita (2013) stated there could be a reverse causality between volatility and international trade, which means international trade help stabilize the fluctuations of exchange rate.

Regional Trade Agreements

A country’s participation in regional trade agreements can also have an effect on the trade flows between countries. By participating in a trade agreement, a country will benefit from decreasing tariffs that are imposed by trading partners, which means that trade costs will be minimized. A study by Caporale et al (2008) examined bilateral trade effects of free trade agreements (FTAs) between the Central and Eastern European (CEEC-4) and the European Union (EU-15) countries. The result indicated that the presence of FTAs leads to a significantly positive impact on trade flows. This variable is commonly expressed through the use of dummy variables, which are utilized (value =1) if the country belongs to a trade agreement.

Definition of Standards and Motivation for Developing Standards

Standards, refer to Directives No. 28/1994 regarding safety and food standards, can be determine as specifications or technical requirements that established, including procedure and method which is based on the consensus of all the parties concerned by observing requirements for safety, security, health, environment, development of science and technology, as well as the experience of the development of the present and future to benefit as much as possible. The objectives of standards are to raise the quality of output, to protect workers, consumer or the environment from potential hazard, or to ensure compatibility among products or intermediates (Moenius 2004). The Organization of Economic Cooperation and development (OECD 1994) suggested that there are two groups of environmental standards: 1) Product standards, and 2) Production and Process Methods (PPMs). Product standards relate to the technical characteristics of the product, as an example performance, quality and safety, while PPMs focus on production and process related standards alluding to the life cycle of a product and highly depending on natural, climatic, technical or economic factors (Stevens 1994).

Motivation for developing standards can be derived from several aspects: preference, environmental and economics. Motivation may be mainly driven by changed preferences (with raising income and a more densely populated world), and better information and communication about production and consumption externalities. In environmental aspects, standards can be motivated by employee protection and animal welfare protection. Environmental measures may be taken on a moral basis, rather than to solve a specific environmental problem. Motivations for setting trade-restricting standards based on values and preferences usually aim at the production process in exporting countries and may example

1Can be accessed through: http://hukor.kemkes.go.id/
include the imports of cosmetics which are tested on animals or other goods which damage the environment in any way.

Economic motivations are generally based on achieving increased transparency, reduced transaction costs and food safety. The economic debate often focuses on compliance cost and competitiveness effects of standards. On the one hand, it is feared that the introduction of costly environmental standards puts the producers and the country as a whole into a disadvantaged competitive situation. On the other hand, there are concerns that environmental standards are motivated by reasons of protectionism to reduce market access for potential competitors (Grote and Kirchhoff 2001).

Standards in product export can drive benefit and loss in a way. Moenius (2006) suggested that standards are helpful for coordinating economic agents’ activities within a unified national or regional market, but are a barrier to imports from others. For agricultural standards, it either increase costs of trade or hinder trade directly. In his findings, Moenius (2004), however, standards of importer countries can have either a negative or a positive effect on trade, and the same is true for harmonized standards. More specifically, importer standards tend to hinder trade in simple goods (including agricultural products) and promote trade in complex goods (like machinery). This happens as standards increase costs of adapting products to foreign markets or meeting process requirements. But they also lower search costs both for producers who want to adapt their products to a specific market as well as for consumers who would otherwise have to search for a certain minimum quality. Moreover, harmonization reduces both product adaptation costs as well as variety, and it depends on which effect dominates in each of these two cases whether standards are trade creating or trade reducing.

Food Safety Standards and Seafood Trade

Growing concerns regarding food standards for better-off consumers and environmental awareness has encouraged countries to implement stricter food safety standards on the products they consume, coming from both local and imported products (Grote and Kirchhoff 2001). Food standards are usually implemented by a developed nation as an import requirement before a product can be brought into the country. In some cases, higher food standards may create a new form of trade barrier.

Standards impact developed and developing countries differently. Anders & Caswell (2009) have examined these differences in their study on the impact of the implementation of Hazard Analysis Critical Control Point (HACCP) in US seafood imports. The study analyzed how the implementation of HACCP has influenced the US seafood trade in developed and developing nations since its introduction in 1997. The result showed that implementation of HACCP had a positive impact on importing seafood from aggregate developed nations, while demonstrating a negative impact for developing nations. That means, HACCP generally acted as a catalyst in seafood imports to the US for developed countries; whereas for developing countries, HACCP acted as a barrier. On a country level, regardless of its development status, leading exporters generally faced a positive effect while smaller exporters experienced a negative effect due to the...
implementation of HACCP. This result is supported by Norbert et al (2010) who conducted similar research and also suggested that smaller traders may suffer more with the implementation of the United States’ HACCP.

Nguyen & Wilson (2009) conducted similar research regarding the establishment of more stringent food safety standards in the seafood trade. The study attempted to capture the impact of food safety standards on three of the largest seafood importers, the US, the EU and Japan. The impact on the top importers was measured by three different standards: the HACCP which was imposed by the US in 1997, the MRPL (Minimum Required Performance Limits) which was imposed by the EU in 2002 and the Food Safety Basic Law which was imposed by Japan in 2003. These three regulations are more stringent than the implemented standards that previously existed. Applying the gravity model with panel data from 123 exporting countries and 17 importing countries (Japan, the US and 15 member states of the EU), the result showed that food safety regulations have affected seafood exports. All three food safety standards led to significant losses in seafood trade.

Several other studies have also tested the impact of food safety regulation on seafood trade by referencing standards on specific chemicals rather than on dummy regulation, as in the aforementioned studies (Kareem; Chen et al 2008; Tran et al 2013). These studies showed similar results which implied that food safety regulations imposed by a country may affect trade flow to the country, regardless the development status of nations. Furthermore, the more stringent the standard, the more the standard acts as a barrier to trade.

As the imposition of standards become more stringent, there are several consequences that must be considered by trading countries. The standards differ across trading countries which imply increasing compliance cost to meet the requested standards. Moreover, government role in ensuring the domestic production to meet the international standards are important.

3 FRAMEWORK

This chapter provides the theoretical foundation and operational framework for this research. The first section discusses the development of international trade theories developed with respect to why it is beneficial for a country to trade and the evolution of trade theory. The second section focuses on the theory underlying the gravity model. The last section provides the operational framework for this study.

The International Trade Theories

International trade can be defined as the economic exchange (capital, goods and services) across international borders. Presently in global economics, countries tend to trade globally. Countries gain many benefits by participating in international trade, including: (i) consumers have the opportunity to be exposed to products that are not available in the country; (ii) encourage industrialization and
infrastructure development through technology transfer; (iii) gain from specialization and market expansion (Auerbach 1996).

Figure 4 portrays the mechanism of international trade between countries. A country tends to export a commodity when its domestic price in autarchy is relatively lower than the price of the same commodity in other country. The relatively low price in a country can reflect a surplus supply of a commodity. As a result, the country (country A) may export its production surplus to other country (country B). On the other hand, country B faces an excess supply in the respective commodity caused by the domestic consumption is higher than its production. The excess supply in country B leads to a high domestic price of the respective commodity. In order to fulfill domestic demand, country B tends to import a relatively low price commodity from other country (in this case country A).

Panel A and C in Figure 4 show the market of a commodity in country A and B. Country A exports its surplus production if its price is higher than Pa while country B imports if its price is lower than Pb. Thus, the difference prices in both countries lead to international trade between country A and B. As a result, the commodity price in the international market will be balanced in world equilibrium price Pe. In this Pe (Pb > Pe > Pa) level, country A export as much as q₂a-q₁a and country B import q₂b-q₁b which is proportional with country A export quantity.

where:

\[ \text{Pa} \] = Autarchy price in country 1,
\[ q^e_a \] = Consumption in country 1,
\[ q^2_a-q^1_a \] = Surplus supply in country 1,
\[ \text{Pb} \] = Autarchy price in country 2,
\[ q^e_b \] = Consumption in country 2,
\[ q^2_b-q^1_b \] = Surplus demand in country 2,
\[ \text{Pe} \] = Equilibrium price on international market,
\[ q^e \] = Export quantity.

The theory of international trade is highly developed. The general economic theory is comprised of three main objectives: (1) to describe the flow of
trade between at least two countries; (2) to measure gains or losses from the trading countries; and (3) to analyze the impact of policy on trade (Morgan and Katsikeas 1997). Classical theories indicate that each country should consider having a trading partner so that it will benefit by exporting goods at a level that achieves economic advantages.

Adam Smith was the first who developed international trade theory, based on the absolute advantage concept. A country has an absolute advantage when it can produce goods more efficiently than another country. This theory emphasizes that the country that is producing a good with an absolute advantage exports the surplus to gain from trade. Trade will occur when another country has an absolute advantage in the production of a different good.

Another classical theory developed by David Ricardo improved upon Adam Smith’s theory. Ricardo’s theory states that international trade will occur when the opportunity cost of producing a good is lower than in other countries. Even though there is no absolute advantage in producing any good, a country will still gain from trade if it can produce the product at a lower autarky price, i.e., at a lower opportunity cost. This theory stresses that a comparative advantage arises from technological differences between countries (Feenstra 2002). Trade occurs as a result of differences in productivity between countries.

In 1933, Eli Heckscher and Bertil Ohlin developed another international trade theory that builds on Ricardian theory. This theory, which is commonly known as the Heckscher-Ohlin (HO) model, or the factor-proportional theory, emphasizes that a country tends to specialize in producing and exporting the good which can be more abundantly produced in accordance with its plentiful factors, while importing products that they have limited production factors. Moreover, the HO model shows that trade flows are driven by differences in factor endowments, i.e., what resources are available in a specific country. This model is based on some basic assumptions: factor productions move freely between sectors, there are differences in factor endowments between trading countries, identical technology exists across countries, and there is a constant return to scale.

The development of the new trade theory (NTT) argued that comparative advantage can be generated separately from factor endowments. This theory, introduced by Paul Krugman, is based on the assumptions of monopolistic competition and increasing returns to scale. In monopolistic competition, all firms produce a unique variety of a differentiated product in order to capture the “love of variety” in consumer demand (Feenstra 2002). Each firm maximizes its profit and increases its production to reduce the average marginal cost. In a monopolistic competition situation, when countries engage in international trade, each country will be importing and exporting differentiated products. Other trade theories can be derived from the monopolistic competition model; an example of this is the gravity model that has been employed to examine the flows of international trade in recent years.

**Barriers on Trade**

Countries use protectionist measures to assure a country’s markets from competition with foreign products. It is implemented through the imposition of
trade barriers, which including tariff and non-tariff barriers. Trade barriers may raise price higher than they would be in the home country when free trade occur. It enhances the market shares of protected domestic producers and limits the volume of exported products into the country.

Figure 5 above depicts the economic effect of trade barriers. In no barriers condition, the world price of P1 would prevail in the market. Country A’s domestic producers would supply Q1, and the country would import Q4-Q1 from the rest of the world. Trade barriers restrict the world supply in Country A, and raise the price to P2. Domestic production increases to Q2, and imports are reduced to Q3-Q2. The total area (a+b+c+d) is a loss in consumer welfare due to the higher prices. The red area (a) is called the redistribution effect because domestic producers gain at the expense of domestic consumers. The yellow area (c) is called the revenue effect. If the trade barrier is a tariff, then the government collects area c in the form of tax revenue. If the trade barrier is a quota, then area c may accrue either to the government, domestic importers, or foreign producers. It depends on the circumstances and relative powers in the market. The combined gray areas (b+d) are known as the "deadweight loss" of trade barriers. The consumer loss of areas (b+d) accrues to no one! If trade barriers are prohibitive, the price would rise to P3 and Country A would have no imports. All production and consumption would be domestic (Emerging Market Access Index, EMAI 2000).

Tariff is a tax imposed on foreign goods as they enter a country, while non-tariff barriers are non-tax measures imposed by governments to favor domestic over foreign suppliers (Coughlin and Wood 1989). Non-tariff barriers (NTBs) cover a wide range of measures, such as: (1) quotas, which is a limit on the quantity that could be imported; (2) excessive customs formalities, which may delay the imports of goods; (3) voluntary export restraints, where bilateral agreements whereby one country voluntarily agrees to restrict the volume of its exports to other country; (4) subsidies, which is a payment by the government to the producers to lower the price of domestic goods and encourage consumers to buy them instead of imports; (5) excessive standard requirements, which could be taking form in health and safety standards, or other standards requirements. In the
excessive standard requirements case, imports are restricted by imposing high standards that could only be met with difficulty by the exporters. This study main focus is in understanding standards as non-tariff measures.

There are different measures to identify NTBs to trade and to estimate their impact on trade (Disdier et al 2007). Four groups can be derived from these measures. (1) Frequency and coverage type measures. The frequency index only accounts for the presence or absence of an NTB. This index does not provide any information on the relative value of affected products. This could be acquired through the coverage index that would be computed using the value of imports occurred in the absence of NTBs as weight. This value is unobservable and therefore imports (home or world imports) are usually used as alternative weights. (2) Price-comparison measures. The purpose of this approach is to observe the effects of NTBs on domestic prices of imported goods by comparing these prices with some reference prices. (3) Price effect measures using import demand elasticities. (4) Quantity-impact measures. This method estimates trade flows mainly by using gravity equation. Information regarding NTB is brought in as explanatory variables. Comparison between actual trade flows and predicted trade flows in the absence of NTBs then provides some indication of the trade restrictiveness of these barriers. Evaluations of trade barriers included in these models are usually based on frequency or coverage indexes. To identify whether standards act as NTB in the canned tuna trade from Thailand, the Philippines and Indonesia, the approach utilized in this study is quantify-impact measures by using gravity equation.

**Trade Flow Analysis Using Gravity Model Approach**

Since its initial introduction by Tinbergen (1962), the gravity model has been widely utilized to determine patterns of international trade. The concept of the gravity model is based on Newton's gravity law which states that the physical force between two objects (F) is proportional directly to the object's mass (M₁, M₂) and inversely proportional to the distance squared between the respective objects (r):

\[
F = G \frac{M_1M_2}{r^2}
\]

In terms of international trade, this means that trade flows between countries (F_ij) are stimulated by economic size as a proxy for mass (M₁, M₂) and the distance between countries (r). The gravity equation is initially formulated as follows:

\[
X_{ij} = \alpha_0Y_i^\alpha Y_j^\alpha D_{ij}^\gamma \eta_{ij} \tag{3}
\]

where \(X_{ij}\) denotes exports of country i to country j, \(Y_i\) and \(Y_j\) denote economic size (GDP) of each country, \(D_{ij}\) denotes distance between country i and j, \(\eta_{ij}\) indicates the error term with \(E(\eta_{ij}|Y_i,Y_j,D_{ij}) = 1\) with \(\alpha_0, \alpha_1, \alpha_2, \text{ and } \alpha_3\) are unobserved parameters. Several studies also account for other variables which may affect trade flows, such as geographical factors, population, common language, historical ties, the exchange rate, regional trade agreement and food standards (Frankel 1997; Rose 2000). These variables can be included in the
Despite having empirical success in predicting trade flows between countries, the gravity model of trade flow analysis have been doubted by many economists due to its lack of theoretical justification (Kepaptsoglou et al 2010). Several researchers have attempted to establish theoretical justification for gravity model analysis. Anderson (1979) provided the initial economic theory by using a Cobb-Douglas function with the following assumptions: (i) identical homothetic or constant elasticity substitution (CES) preference, and (ii) goods are differentiated by place of origin. Moreover, Bergström (1990) and Deardoff (1998) developed theoretical foundation using CES preference and to explain specialization, added monopolistic competition or a HO models. By applying the assumptions from the Anderson and Deardorff theories, Anderson and van Wincoop (2003) derived the gravity equation by adding trade resistance (trade cost) into the original gravity formulation. Trade resistance in the Anderson and van Wincoop (AvW) model can be intuitively divided into three components: (i) trade barriers between region i and j, (ii) resistance of region i to trade with other regions, and (iii) resistance of region j to trade with other regions.

The gravity model by AvW is derived from demand function. The structure for the consumer is based on CES preference. Consumers have “love of variety”, indicating that their utility increase by consuming more products as well as consuming a wider variety of products. Meanwhile on the production side, each region is specialized in producing only one good. In order to fulfill consumers’ demand for product varieties, the producers sell its products across the region. However, by exporting the products it means the producers face trade cost including information costs, legal and regulation costs and transport cost as well. This trade cost is passed by the exporter to the importer. As a result, price differs across the region. Based on these assumptions (consumers’ preference and specialization in the production), the equilibrium can be derived: firms produce goods for domestic and international market, and consumers consume accordingly. In aggregate, these foundations derive the gravity model. The AvW gravity equation can be written as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y^w} \left( \frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma}$$  \hspace{1cm} (5)

Taking a logarithm of the equation (5),

$$\ln X_{ij} = \ln Y_i + \ln Y_j - \ln E_j - \ln Y + (1-\sigma) \left[ \ln t_{ij} - \ln \Pi_i - \ln P_j \right]$$ \hspace{1cm} (6)

where, $Y^w$ indicates global income (world GDP), $t_{ij}$ indicates all bilateral resistance that is assumed to be symmetric $t_{ij} = t_{ji}$, $\Pi_i$ and $P_j$ are the multilateral resistance variables, with $\Pi_i$ is the outward multilateral variable that captures exports from country i to j relying upon trade cost across all possible export market, while $P_j$ is the inward multilateral resistance that captures imports from country i to j relying upon trade cost across all possible suppliers, and $\sigma$ is the elasticity of substitution between all goods (Shepherd 2013). The AvW gravity
equation implies "trade between region is determined by relative trade barriers" (AvW 2003). Anderson and van Wincoop have suggested using a non-linear regression or OLS with a fixed effect to capture multilateral resistance.

The Exchange Rate and Trade

The exchange rate of an economy affects aggregate demand through its effect on export and import prices. Figure 6 below portrays the impact of exporter currency appreciation on trade. The four-panel diagram shows the United States as an exporter on the left panel, trade on the second panel, exchange rates on the third panel, and the rest of the world on the last panel. A stronger dollar increases the relative price of the product in the rest of the world, decreasing demand for and reducing exports from the US.

The initial quantity traded before the appreciation of the US dollar is at point Qt, and the price of the good at this quantity traded is at P. The strengthening of the dollar is illustrated by a downward shift in the exchange rate line (1:1), effectively depreciating the importer currency. After shifting the currency line, begin at the equilibrium of the import market, point B, and move left until reaching the original currency line at point C. Take that line down to the new currency line, point D. Continue left from point D to the US price axis. This line is the new price level for the exporter, increasing quantity demanded by J and decreasing quantity supplied by K in the export country’s market. At point E, where the new price intersects the trade price axis, the new Excess Demand line is drawn by connecting point E to the intercept point on the horizontal axis of the original ED. Point F is the new quantity traded, with a decrease in the amount of L. From point F, a line is drawn back to the new currency line (point G) up to point H on the 1:1 line and to the right through the importer supply and demand axis. This show that the impact of the currency appreciation in the export market is a decrease in quantity demanded and an increase in quantity supplied in the amount of M (Kristinek& Anderson 2002).

Figure 6 The impact of exporter currency appreciation on trade
Source: Kristinek and Anderson (2002)
In other words, appreciation of an economy will induce: (1) an increase in foreign price of exports which implies exports become more expensive. Therefore a decrease of export quantity can be expected; (2) imports become cheaper as the consumers can afford a greater quantity of the imported goods. Therefore an increase of import quantity can be expected; (3) lower economic growth. As export demand decrease and import spending increase, domestic aggregate demand can be expected; (4) lower inflation caused by a decrease in import prices, lower aggregate demand and greater incentives to manufacturers as the export prices become expensive (Goldberg and Knetter 1996; Anonymous 2014).

**Operational Framework**

Tuna is one of a most important commodity traded in fish and fishery products, which majorly traded in canned. Thailand, the Philippines and Indonesia are three main exporters from Asia which contributes more than 60 percent of world canned tuna supply. Demand for canned tuna is globally dispersed and likely to increase each year.

Several factors may affect the trade flows of canned tuna trade, namely canned tuna production in the exporting countries, GDP of the importing countries, remoteness, exchange rate, participation in the free trade area and food standards. The canned tuna production in the exporting countries and GDP of the importing countries portray the supply and demand of traded countries. As the production increases, the ability to export increases as well. For the importing countries as the GDP increases, the ability to absorb canned tuna export increases. Both the production of canned tuna and GDP is expected to have positive effect to canned tuna export.

On the other hand, remoteness acts as trade resistance between the exporting and importing countries. As the remoteness of the exporting countries increases, the canned tuna export tends to decrease. Thus, remoteness is expected to have a negative effect to canned tuna export. The increasing of exchange rate
encourages country to export more. In other words, the exchange rate is expected to have a positive effect to canned tuna export. Similarly, participation in trade agreement is expected to have a positive effect to canned tuna export. Engage into trade agreements may support international trade since it minimizes trade resistance between countries. In contrast, food standards are expected to have a negative effect to canned tuna export. As the required standards to enter foreign market become tighter, the canned tuna export from Thailand, the Philippines and Indonesia tends to decrease.

This study aim is to analyze whether those factors above are affecting trade flow of canned tuna by utilizing gravity model of trade. The operational framework of this research is portrayed in Figure 7. Based on explanation above, hypothesis of this study are:

1. Canned tuna production has a positive effects on canned tuna trade
2. GDP of importing countries has a positive effects on canned tuna trade
3. Remoteness has a negative effects on canned tuna trade
4. The exchange rate has a positive effects on canned tuna trade
5. Participation in free trade agreements (FTAs) has a positive effects on canned tuna trade
6. Standards has a negative effects on canned tuna trade

4 RESEARCH METHODOLOGY

This chapter describes the methodological approach of this research. The first part gives a description of the type and source of data used in the study. The second part portrays the data analysis using the gravity model and the estimation techniques. The third part provides the gravity model formulation as utilized in the canned tuna trade.

Types and Sources of Data

The secondary data used in this research consists of both time series and cross-sectional dataset, with an observational period of 14 years, 2000 to 2013. The cross-sectional data consists of an annual export value of three exporting countries (Thailand, Indonesia and the Philippines) paired with 50 importing countries. A list of the importing countries is available in Table A1 (Appendix).

The object of this research is tuna, skipjack, bonito prepared/preserved, not minced using classification of harmonized system (HS) 1996 with code 160414. The respective data has been obtained from several sources, such as the United Nations Commodity and Trade (UN Comtrade) Statistics Database, the World Bank, the FAO, the Centre d’Études Prospectives et d’Informations Internationales (CEPII), the Ministry of Marine Affairs and Fisheries Republic of Indonesia (MMAF), the Asia Regional Integration Center (ARIC), the Canadian Food Inspection Agency (CFIA), the United States Department of Agriculture (USDA) and the Southeast Asian Fisheries Development Center (SEAFDEC). Other supporting data has been from various literature sources such as thesis,
journal articles and books related to this topic. Table 1 below shows the sources for various factors needed in the model.

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export value of tuna</td>
<td>US$</td>
<td>UN Comtrade</td>
</tr>
<tr>
<td>Total production of tuna</td>
<td>MT</td>
<td>FAO - Fisheries and Aquaculture</td>
</tr>
<tr>
<td>GDP</td>
<td>US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>Real exchange rate</td>
<td>US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>Distance</td>
<td>Kilometer</td>
<td>CEPII</td>
</tr>
<tr>
<td>Trade Agreement</td>
<td></td>
<td>ARIC</td>
</tr>
<tr>
<td>Food Standards</td>
<td></td>
<td>CFIA, Global Agriculture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Information Report (GAIN) USDA, SEAFDEC</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration

Panel Data Analysis Using Gravity Model

The data analysis is conducted using gravity model estimation. This method is used here to analyze trade flows of canned tuna and whether the implementation of food standards in a destination country has a significant influence on the international trade flow in Thailand, the Philippines and Indonesian tuna exports to 50 destination countries. Data is processed using Microsoft Excel and Stata version 13.0. In this research, two approaches are used in estimating the gravity model: (1) Ordinary Least Squares (OLS) and (2) Pseudo Poisson Maximum Likelihood (PPML).

There are different standards imposed by destination countries, that are: (1) using the international standards (CAC) and (2) using national standards that stricter than the CAC. In order to capture how the different standards imposed by the destination countries affecting Thailand, the Philippines and Indonesia canned tuna exports, the dummy variables are used by categorizing the standards. This approach is used by Pelletiere and Reinert (2006) to measure the level of protection in used automobiles. Table 2 presented the category of standards.

Ordinary Least Square (OLS)

In this study, factors affecting trade flows of canned tuna and impact of the implementation of food safety standards is analyzed. The gravity equation can be written as follows:

\[ Y_{ij} = \beta_0 \cdot \text{Prod}_i^{\beta_1} \cdot GDP_j^{\beta_2} \cdot R_{ij}^{\beta_3} \cdot ER_{ij}^{\beta_4} \cdot e^{\beta_5R_{ij} + \beta_6FSA_{ij}} + \epsilon_{ij} \]  

To estimate equation (7), the multiplicative gravity model transforms into a log-linear model:

\[ \ln Y_{ij} = \beta_0 + \beta_1 \cdot \ln \text{Prod}_i + \beta_2 \cdot \ln GDP_j + \beta_3 \cdot \ln R_{ij} + \beta_4 \cdot \ln ER_{ij} + \beta_5 \cdot FSA_{ij} + \epsilon_{ij} \]  

where \( Y_{ij} \) indicates annual total value of the tuna trade exported from country i (Thailand, the Philippines and Indonesia). Prod, indicates annual tuna production in country i. GDP_j is real GDP of country j. R_{ij} measures remoteness of country i to
country j. ER\textsubscript{ij} is the exchange rate between country i and country j. FS\textsubscript{j} is a dummy variable which is valued at 1 if country j has imposed food standard regulations. FTA\textsubscript{ij} is a dummy variable which is valued at 1 if both countries i and j participate in free trade agreements.

Table 2 The Dummy Categories of Standards

<table>
<thead>
<tr>
<th>Categories</th>
<th>Standards Description</th>
<th>Number of Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A country imposes international standards (CAC)</td>
<td>24 16</td>
</tr>
<tr>
<td>1</td>
<td>A country imposes its national standards by taking into consideration a maximum limit of chemical contaminants and drug residues that are stricter than international standards</td>
<td>26 8</td>
</tr>
<tr>
<td>2</td>
<td>A country establishes a more restricted maximum limit of chemical contaminants and drug residues than it was in the previous years</td>
<td>0 1</td>
</tr>
<tr>
<td>3</td>
<td>A country not only establishes maximum limit of chemical contaminants and drug residues but also requires specific certification (catch certificate and/or eco-labeling)</td>
<td>0 25</td>
</tr>
<tr>
<td></td>
<td>Total countries</td>
<td>50 50</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration

Typically, the data sets used in gravity model estimations are cross-sectional data. However, the dataset used in this research is panel data which consists of time series and cross-sectional data. There are several advantages to using panel data rather than cross-sectional or time series data. Panel data improves the efficiency of econometric estimation by providing a large number of observations, increasing the degree of freedom and diminishing collinearity among dependent variables. Moreover, panel data can be used to explain economic questions that time series and cross-sectional data cannot describe, such as variables that change over time but not across entities (Hsiao 2003).

In estimating the parameters of the model with panel data, there are two techniques that are commonly used, namely the Fixed Effect Model (FEM) and the Random Effects Model (REM). FEM assumes that there is a correlation between the individual and/or time specific effects with explanatory variables. In contrast, REM assumes that there is no correlation between the individual with the explanatory variables. In order to determine if the data should be estimated by FEM or REM, it is necessary to test the assumption of the existence of a correlation between the regressors and the individual effects; the Hausman Test
can be used in testing this assumption. According to Anderson and van Wincoop (2003), the initial gravity model failed to consider multilateral resistance terms that may lead to biased estimation results. To take the multilateral resistance into account, they suggested using OLS estimation with a fixed effect approach. The fixed effect is employed by putting the dummy of country-specific effect into the estimation. This dummy is used to capture all source of unobserved heterogeneity, that constant for a given exporter across all importers as well as constant for a given importer across all exporters.

Poisson Pseudo Maximum Likelihood Estimation

Estimating the gravity model with the logarithmic transformation may lead to certain problems, particularly when trade data contains observations with zero values. A zero value may occur for several reasons, such as no trade condition existing in a given period, rounding the errors due to trade values which did not reach a minimum value, or missing observations (Santos Silva and Tenreyro 2006). Various methods have been used in dealing with zero trade observations: (i) utilization of the truncation method by completely deleting the zero trade observation, and (ii) adding a small value to the zero observation before taking the logarithmic transformation (Kareem et al). Moreover, applying these methods may result in a loss of information and lead to inconsistent estimates as the data would potentially suffer from a sample selection biased (Heckman 1979; Linders and de Groot 2006; Herrera 2010).

Empirical studies have provided other estimation techniques for dealing with zero-value observations. An approach proposed by Santo Silva and Tenreyro (2006) is to employ the Pseudo Poisson Maximum Likelihood (PPML) estimator. They suggested rather than using log-linear gravity equation, estimated in its multiplicative form by using PPML would lead to a better result. Not only does this approach overcome the zero value trade observation problems, but also this technique is also consistent in the presence of heteroskedasticity. Furthermore, interpretation of PPML follows OLS estimation although the dependent variable in PPML is in levels. The coefficient of the independent variables can be interpreted as elasticities and semi-elasticities depending on whether the independent variables are entered in logarithms or not (Shepherd 2013). The PPML estimator can be written as below:

$$\sum_{jt}^{n} y_{jt} - \exp(x_{ijt} \beta) y_{ijt} = 0 \quad \text{................................................................. (9)}$$

where $x_{ijt}$ are the explanatory variables of the gravity equation and $\beta$ is the parameters.

Model Formulation of Canned Tuna Trade

This study analyzes canned tuna trade flows and how food standard regulations affect trade through the utilization of gravity models. Independent variables used in this model include: annual tuna production in exporting countries, GDP of importing countries, the distance between countries/remote/ness, exchange rate, dummy variables of food standards imposed by destination countries, and participation in free trade agreements.
For the purpose of comparison and to obtain a better solution, there are two model formulations used in this research, the OLS and PPML estimations. The model equations can be written as follows:

\[
\ln Y_{ijt} = \beta_0 + \alpha_i + \alpha_j + \beta_1 \ln \text{Prod}_{it} + \beta_2 \ln \text{GDP}^t_j + \beta_3 \ln R_{ij} + \beta_4 \ln \text{ER} + \beta_5 D_{FS1}^t_j + \beta_6 D_{FS2}^t_j + \beta_7 D_{FS3}^t_j + \beta_8 \text{FTA}_{ijt} + \varepsilon_{ijt} \tag{10}
\]

\[
Y_{ijt} = \exp\{\beta_0 + \alpha_i + \alpha_j + \beta_1 \ln \text{Prod}_{it} + \beta_2 \ln \text{GDP}^t_j + \beta_3 \ln R_{ij} + \beta_4 \ln \text{ER} + \beta_5 D_{FS1}^t_j + \beta_6 D_{FS2}^t_j + \beta_7 D_{FS3}^t_j + \beta_8 \text{FTA}_{ijt} + \varepsilon_{ijt} + \varepsilon_{ijt}\} \tag{11}
\]

where:

- \( Y_{ijt} \) = annual export value of exported tuna from country i to country j (US$),
- \( \text{Prod} \) = annual production of tuna in country i (MT),
- \( \text{GDP}^t_j \) = GDP of country j (1000US $),
- \( \text{R}_{ij} \) = remoteness of country i from country j,
- \( \text{ER}_{ij} \) = real exchange rate between country i to j (US $),
- \( D_{FS1}^t_j \) = dummy variable of FS1 imposed by country j in year t,
- \( D_{FS2}^t_j \) = dummy variable of FS2 imposed by country j in year t,
- \( D_{FS3}^t_j \) = dummy variable of FS3 imposed by country j in year t,
- \( \text{FTA}_{ijt} \) = dummy variable of trade agreement between country i and j.
- \( \alpha_i \) = importer specific effects,
- \( \alpha_j \) = exporter specific effects,
- \( \beta_0 \) = intercept,
- \( \beta_n \) = estimated parameter (n=1,2,..8) with \( \beta_1, \beta_2, \beta_4, \beta_8 > 1 \) and \( \beta_3, \beta_5, \beta_6, \beta_7 < 1 \),
- i = exporting countries (Thailand, the Philippines, Indonesia),
- j = destination countries.

**Hypotheses Testing and Goodness of Fit**

The purpose of hypothesis testing is to determine whether the regression coefficients are statistically significant (Nachrowi and Usman 2006). There are two common methods used of testing hypotheses, namely:

- **F-test**
  
  This test is intended to determine whether the independent variables in the model jointly affect the dependent variable. The formulation of the F-test is as follows (Anderson et al. 2009):
  
  \[
  H_0: \beta_1 = \beta_2 = \beta_3 = \ldots = \beta_k = 0 \\
  H_1: \text{There is at least one } \beta \text{ value that is not equal to zero}
  \]

  The test criteria is if \( F_{\text{statistic}} > F_{\text{table},(k-1)/(n-k)} \), then \( H_0 \) can be rejected, where \( k \) is the number of variables and the number of observations is denoted with \( n \). Additionally, if the probability (p-value) < significance level, then there is adequate evidence to reject \( H_0 \). Rejecting \( H_0 \) indicates that the independent variables in the model jointly have a significant effect on the dependent variable at the significance level of \( \alpha \) %.

- **T-test**
This test is intended to determine whether the independent variables individually have a significant effect on the dependent. The formulation of the T-test is as follows (Anderson et al 2009):

\[ H_0: \beta_j = 0 \]

\[ H_1: \beta_j \neq 0; \text{ where } j = 0, 1, 2, \ldots, k, \text{ with } k \text{ representing slope coefficient} \]

The test criteria is to reject \( H_0 \) if \( |t_{\text{statistics}}| > t_{\alpha/2;n-k-1} \) or \( P < \alpha \), which implies that independent variables significantly affect the dependent variable.

- **Goodness of Fit**

  The goodness of fit \( (R^2) \) aims to measure the variation amongst the independent variables that can be explained by the dependent variable. The formula for goodness of fit is expressed in the following equation (Anderson et al. 2009):

\[
R^2 = 1 - \frac{\sum (Y_i - \hat{Y}_i)^2}{\sum (Y_i - \bar{Y})^2}
\]  

The result of the goodness of fit estimation ranges from zero to one \((0 < R^2 < 1)\). If the value of \( R^2 \) is close to one, it indicates that much of the variation of the independent variables in the model can be explained by the dependent variable.

### 5 GENERAL OVERVIEW OF CANNED TUNA INDUSTRY

Tuna is a highly migratory species that are widely spread throughout all oceans in the world, especially in tropical warm temperature oceans. According to the FAO (2014b), from 1950 to 2012 the global amount of tuna captured commercially increased from 415,000 MT to 4.8 million (Figure 8). The majority of this catch occurs in three regions: the Pacific, Indian, and Atlantic Oceans. The Pacific Ocean contributes the largest share of global tuna yields at approximately 64 percent, while the Indian and Atlantic Oceans contributes 25 percent and 11 percent, respectively (Miyake et al 2010).

![Figure 8 Worldwide catches of commercial tuna, 1950-2012](Source: Author’s elaboration with data from FAO-FishstatJ (2015))
The most common captured tuna species are yellowfin, skipjack, albacore, big eye and bluefin (Atlantic, Pacific and Southern Bluefin). According to the FAO-FishstatJ (2015), in 2012 skipjack catches accounted for the highest share of all species at roughly 57.1 percent, followed by yellowfin at 27.6 percent and albacore at 5.2 percent of the total tuna catch. The global increase of tuna captures is mainly due to improvement in technology and fishing methods which increase fishing efficiency. Examples of improved technology or methods include fishing gear, fishing vessels and navigation systems which have helped to improve efficiency in the sector (Miyake et al. 2010). In recent years, purse seine, longline and pole-and-line are three types of gear which has accounted for the vast majority of global tuna catches. The purse seine targets schools of yellowfin and skipjack and the catches tend to be smaller than catches by longline. Most of the catches from the purse seine method are sent to the canning industry. Meanwhile, the large bigeye, albacore and yellowfin are the primary species targeted by longline fishing. As for the pole-and-line method, the vessels are mainly used to catch skipjack, small yellowfin, albacore and bluefin tuna. Of the three methods, the large purse seine vessels currently dominate global tuna fishing (Kuldilok 2009).

Tuna is traded in the international market in several forms, specifically fresh, frozen, canned and dried (commonly called katsuobushi) tuna. The demand for canned tuna has increased remarkably over the past few decades due to having a competitive price (generally lower than other forms of traded tuna) and providing a high source of protein. Annually, about 2.5 million MT of the global tuna catch (more than 50 percent of the total tuna catch in 2012) is sent to the canning industry.

**Description and History of Canned Tuna**

Skipjack, yellowfin and albacore are the tuna species which are generally used for the canning industry. Due to the differences in meat colour, there are two different types of canned tuna. Canned albacore is known as white meat tuna, while canned skipjack and yellowfin are known as light meat tuna. White meat tuna, among other canned tuna products, is considered to be a luxury product which has a distinctive taste. As for light meat tuna, yellowfin which has a solid skin and produces less waste is considered to be the best quality light meat tuna (FAO Globefish 2003).

The canned tuna industry began in the early 1900s, originating in Japan in 1906. Early production occurred on an experimental basis and grew rapidly after the First World War when the Japanese tuna industry had access to large fishery resources in Micronesia. Most tuna catches in this area were yellowfin and skipjack, which were then processed into katsuobushi, while a small quantity of albacore (minor catches in Japanese tuna fishing) were processed by the canning industry. The United States became the second canning tuna producer in 1909 when tuna was considered to be a substitution for canned sardines following the depletion of sardine catches. Initially, only albacore was processed as a canned product in the US, but due to the increasing demand for canned tuna and the development of bait boat fishing in the 1950s, the United States began canning
other species of tuna such as skipjack, bluefin and yellowfin. Since this time, the United States has been the largest producer and consumer of canned tuna worldwide. In the 1970s, as the tuna industry from Asian countries (Thailand, the Philippines and Indonesia) emerged, the United States tuna industry began to decline due to low-cost competition. As a result, nearly all of the processing plants in the United States were closed down and moved to US territories in American Samoa (Miyake et al. 2010). Thailand, the Philippines and Indonesia emerged as the new major processors canned tuna industry; moreover, these three nations are the main focus of this study.

Development of Canned Tuna Industry in Thailand, the Philippines and Indonesia

Having extensive fishing resources, as well as a relatively low cost of labour, the canned tuna industry in Thailand, the Philippines and Indonesia has grown rapidly since it originally began operations in the 1970s (Figure 9). Thailand has experienced exponential growth in canned tuna production compared to the Philippines and Indonesia.

![Graph showing canned tuna production in Thailand, the Philippines, and Indonesia (1976-2011)](image)

**Figure 9** Thailand, the Philippines and Indonesia canned tuna production, 1976-2011

Source: Author’s elaboration with data from FAO-FishstatJ (2015)

Thailand

Currently, Thailand is the world’s largest canned tuna exporter, contributing 46 percent to the global tuna trades net weight, a figure which is four times higher than other exporters. Thailand has two sectors of tuna export: fresh and frozen sashimi caught by longline vessels, and processed canned tuna caught by purse seine vessels. In 2006, approximately 96 percent of all tuna exports from Thailand are canned products (Kuldilok et al. 2013). Thailand’s tuna industry began operation in the early 1970s and has grown rapidly over the last three decades. In 1972, only one cannyy was in operation, SAFCOL Ltd. (now Kingfisher Holdings Ltd.), the result of an Australia, Thai and Hong Kong
partnership (Kuldilok 2009). In recent years, Thai tuna production has reached an annual production of 700,000 MT through operation in 30 canneries in Thailand, the majority of which are located in Bangkok (Hamilton et al. 2011). Thailand's canning industries are dominated by two processors, Thai Union with a production capacity of around 1,000 MT/day and Sea Value with 850 MT/day. Thai Union and Sea Value are the world largest and second largest tuna producers. An overview of Thailand tuna processors is showed in Table 3.

Table 3 Overview of Major Tuna Processors in Thailand, 2010

<table>
<thead>
<tr>
<th>Company</th>
<th>Processing Capacity (MT/day)</th>
<th>Company Structure and Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai Union</td>
<td>1,000 (240,000 MT/year)</td>
<td>• Established in 1988&lt;br&gt;• World's leading tuna producer&lt;br&gt;• Investments in tuna processing plants in the US, China, Vietnam, Indonesia, Papua New Guinea, France, Portugal, Seychelles and Ghana</td>
</tr>
<tr>
<td>Sea Value</td>
<td>800-850</td>
<td>• Established in 2004&lt;br&gt;• World's second largest tuna producer&lt;br&gt;• No overseas investments in tuna processing plants</td>
</tr>
<tr>
<td>Kingfisher Holdings Ltd.</td>
<td>200 (40,000 MT/year)</td>
<td>• Formerly SAFCOL, established in 1972&lt;br&gt;• Highly diversified processors, focussing on quality&lt;br&gt;• No overseas investments in tuna processing plants</td>
</tr>
</tbody>
</table>

Source: Hamilton et al (2011)

Due to low tuna resources in Thailand’s seas and relatively few fishing fleets, the supply of raw materials rely heavily on import. In 2009, Thailand’s tuna processors imported around 85 percent, or 811,621 MT, of raw canning materials, sourced mainly from the Western and Central Pacific Ocean with the fleets coming primarily from Taiwan (20 percent), the United States (19 percent), South Korea (16 percent) and Vanuatu (11 percent) (Aramwatananont 2010).

There are several reasons underlying the rapid development of Thailand’s tuna canning industry. First, Thailand is a trade-oriented economy, with total exports accounting for 76 percent of its gross domestic product (GDP) in 2006 (Kuldilok et al. 2013). Second, Thailand is known to have a well-established food processing industry, a sentiment can be extended to the tuna canning industry. Moreover, many tuna canneries have been converted from other food canneries, therefore having already established production standards. Third, Thailand is strategically located, allowing for raw materials to be accessed from the Pacific and Indian Oceans. Fourth, Thailand has a low cost labour force, which at around US$152/month is lower than many other tuna producing countries such as Spain (US$1,829/month), Ecuador (US$332/month) and the Philippines.
Finally, Thailand’s government policy focused on supporting infrastructure development and stimulating new products and exporters to meet international demand by giving substantial incentives (Miyake et al. 2010; Hamilton et al. 2011; Kulilok et al. 2013).

The Philippines
Located in the Pacific Ocean which has abundant tuna resources, it is not surprising that the Philippines is one of the world’s largest commercial tuna producers. In 2007, the Philippines contributed 11.36 percent to the total commercial tuna production worldwide, or the second largest producer after Indonesia (SFP 2010). Even though tuna resources are widely spread all over Philippine waters, the main production areas are situated in the Sulu Sea, Moro Gulf/Celebes Sea, and South China Sea. Despite extensive fishing opportunities within the Philippines, the country is also known to catch in Western and Central Pacific Ocean (WCPO) waters such as Papua New Guinea, Indonesia and the Solomon Islands through bilateral access trade agreements (Vera and Hipolito 2007). The purse seine fleet of the Philippines is one of the largest operating fleets in the WCPO with 40 large vessels and 55 smaller vessels as of 2009 (Hamilton et al 2011).

Table 4 Overview of Major Tuna Processors in the Philippines, 2010

<table>
<thead>
<tr>
<th>Cannery</th>
<th>Ownership</th>
<th>Production Capacity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Tuna</td>
<td>Philippines</td>
<td>200 MT/day (85,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Philbest Canning</td>
<td>Philippines</td>
<td>140 MT/day (40,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Alliance Tuna Int.</td>
<td>Publicly listed company</td>
<td>150 MT/day (30,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Ocean Canning</td>
<td>Philippines</td>
<td>100 MT/day (15,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Seatrade Canning</td>
<td>Philippines</td>
<td>80 MT/day (15,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Celebes Canning</td>
<td>RD consortium</td>
<td>80 MT/day (10,000 MT/year)</td>
<td>General Santos</td>
</tr>
<tr>
<td>Parmex P &amp; E</td>
<td>International private company</td>
<td>100 MT/day (25,000 MT/year)</td>
<td>Zamboanga</td>
</tr>
</tbody>
</table>

Source: Hamilton et al. (2011)

The tuna commodity was exported primarily as a canned product (72 percent), while fresh and frozen products jointly contributed 29 percent to total exports in 2003 (Vera and Hipolito 2007). Initially, tuna processors developed in Manila, Zamboanga and General Santos in the late 1970s after the emergence of the purse seine fishing techniques were successfully adopted (Lewis 2004). In 1982, production of canned tuna was around 40,000 MT, an increase which helped fulfill domestic tuna production. In order to meet increasing export demand and declining domestic tuna supply, larger vessels were dispensed to gain
fishing yields in Papua New Guinea and Indonesia to supply raw materials for the canning industry.

Presently, seven canneries are operating in the Philippines with a total production capacity of 850 MT/day in 2009 and an estimated total production of 220,000 MT per annum (Hamilton et al. 2011). Additionally, the Philippines has two canneries located in Indonesia and Papua New Guinea, respectively, with a total production capacity of 20,000 MT and 30,000 MT per annum (Vera and Hipolito 2006). Domestic purse seine vessels are the source of the majority of raw materials (approximately 130,000 MT) that go into canned tuna production.

**Indonesia**

Indonesia is the world’s largest archipelago nation, which has a marine fisheries area of 5.8 million km$^2$, including 2.7 million km$^2$ of highly productive economic exclusive zone (EEZ) located in the Pacific and Indian Oceans that has large tuna resources. In 2007, Indonesia became the largest tuna producing country by contributing 12.45 percent to the total world commercial tuna production, followed by the Philippines with 11.36 percent and Japan with 10.23 percent (SFP 2010).

For fishery management and monitoring purposes, the Indonesian government, through the establishment of ministry regulation 01/2009, divided the Indonesian EEZ into 11 Fishery Management Areas (FMAs). There are 8 FMAs in the Pacific Ocean and 3 FMAs in the Indian Ocean. Tuna production and fishing activity occur primarily in the Pacific Ocean, specifically in the Sulawesi, Maluku, Halmahera, Flores and Banda seas (Miyake et al. 2010). Since tuna resources are abundant and well-dispersed, there are several landing ports which are conveniently located near fishing sources. Bitung, Sorong, Kendari, Ternate, Ambon and Biak are the main tuna landing ports in the eastern part of Indonesia. In the western and middle parts of Indonesia, the main landing ports are Muara Baru (Jakarta) and Benoa (Bali) (SFP 2010).

Indonesian fishing fleets are multi-gear and multi-species by nature, and majorly artisanal in scale (Miyake et al. 2010). The commercial purse seines and longlines account for only three percent of the total number of fishing vessels. Most of the country’s tuna catches are within the Indonesian EEZ since its fishing fleets generally operate on a small scale and with a limited range.

Indonesian tuna exports experienced rapid growth from 1981 (14,400 MT) to 1991 (1,034,000 MT) with an annual average growth rate of approximately 17 percent. Canned tuna dominates Indonesian tuna exports by accounting for 44 percent of total production, followed by frozen tuna (loin, steak and fillet) with 29 percent, and fresh/chilled tuna or high quality tuna for sashimi with 27 percent (MMAF 2007).

Currently, there are at least 13 canneries which are primarily processing tuna and have an estimated production of about 100,000 MT per annum. Indonesian tuna canneries are situated in several locations: east Java, Bitung, Bali, Sorong and Biak (Hamilton et al. 2011). The supply of raw materials in the canneries comes mostly from local vessels. Captured tuna is generally unloaded in the nearby ports or taken directly to the canneries. In the situation when the canneries are too far from the fishing source, the raw materials are transported...
from the nearest port (which may be located in another part of the country) or imported from either the Indian Ocean or the Western and Central Pacific Ocean. An overview of the tuna canning industry in Indonesia can be seen in Table 5.

<table>
<thead>
<tr>
<th>Cannery</th>
<th>Location</th>
<th>Structure/Owninghip</th>
<th>Source of Supply</th>
<th>Annual production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinar Pure food</td>
<td>Bitung</td>
<td>Consortium (the Philippines and Indonesia)</td>
<td>Local vessels</td>
<td>20,000</td>
</tr>
<tr>
<td>International Alliance Food</td>
<td>Bitung</td>
<td>Philippines parent with 30 percent Indonesia</td>
<td>Local vessels</td>
<td>5,000</td>
</tr>
<tr>
<td>Deho</td>
<td>Bitung</td>
<td>Indonesia</td>
<td>Local vessels</td>
<td>5,000</td>
</tr>
<tr>
<td>Delta Pacific</td>
<td>Girian, close to Bitung</td>
<td>Indonesia</td>
<td>Local vessels</td>
<td>5,000</td>
</tr>
<tr>
<td>Indotuna</td>
<td></td>
<td></td>
<td>Local vessels</td>
<td>8,000</td>
</tr>
<tr>
<td>Citra Raja</td>
<td>Sorong</td>
<td>Indonesia with the Philippines’ equity</td>
<td>Local vessels</td>
<td>8,000</td>
</tr>
<tr>
<td>PT. Aneka Tuna</td>
<td>Pasuruan, East Java</td>
<td>Joint venture with Japan</td>
<td>Some local, some imported</td>
<td>30,000</td>
</tr>
</tbody>
</table>

Source: Hamilton et al. (2011)

The canning industry in Indonesia has many advantages. First, Indonesia has abundant tuna resources to accommodate for raw materials in the canning industry. Second, Indonesia has a productive and cheap labour force (US$94/month, which is even lower than the cost of the labour force in Thailand). Third, Indonesia has an adequate infrastructure which can support the industry. Nevertheless, widely dispersed unloading ports and relatively high international transportation costs compared to other exporters (Thailand) are the main disadvantages faced by Indonesian canneries (Hamilton et al. 2011).

6 RESULTS

This chapter explains the result and discussion of the gravity estimation of the canned tuna trade from Thailand, the Philippines and Indonesia to 50 importing countries during a 14 year trading period. The first section depicts trade flows of canned tuna. Standards on fish and fisheries trade are explained in the second section. The third section showed factors affecting trade flows on canned tuna. The last section explains differences between the OLS and PPML estimation techniques and provides an interpretation and explanation regarding the estimation of the gravity model of the canned tuna trade.
Trade Flows of Canned Tuna

The total export of canned tuna from Thailand, the Philippines and Indonesia are expected to gradually increase each year (Figure 10). According to UN Comtrade (2013), in 2009, Thailand canned tuna exports declined by 13.1 percent in value, worth US$347 million. The Philippines and Indonesia, however, have constantly experienced increasing tuna exports.

In terms of imports (Figure 11), the European Union is the largest market, importing 45 percent of the total canned tuna in 2012 (US$667 billion), followed by the United States (18 percent), Japan (4 percent), Australia (4 percent) and Egypt (4 percent). In the EU market specifically, Italy was the largest importer accounting for 11 percent of total world canned tuna, followed by France (8 percent) and Spain (8 percent).

Figure 12 below portrays main canned tuna export destination countries for each exporter. Thailand export (Figure 11 a) is dispersed where the US become the main export destination contributing 22 percent of total Thailand canned tuna export in 2012, followed by the EU (12 percent), Australia (9 percent), Egypt (8 percent) and Japan (7 percent). The Middle East countries such
as Libya, Saudi Arabia and United Emirate Arab also contribute large amount of export which accounted 13 percent in total. The Philippines export (Figure 11 b) shows fewer destination countries where the EU is the major canned tuna export destination accounted 69 percent of total export in 2012 followed by Japan (20 percent), Canada (4 percent) and Australia (3 percent). While Indonesia export (Figure 11 c) shows more disperse export destination countries than the Philippines where the EU become the largest market contributing 23 percent of total canned tuna export, followed by Japan (17 percent), Saudi Arabia (15 percent) and the US (14 percent).

![Canned tuna importers for each exporter by value, 2012](source: Author’s elaboration with data from UN Comtrade (2013))

**Standards on Fish and Fishery Trade**

In the international market, exporting countries have to comply with certain standards and regulations in order to ensure its products meet the requirement in the target market. The implementation of standards can impact trade in several ways: (1) facilitate trade by specifying products, (2) provide public assurance of safe and high quality products through setting safety standards requirements and (3) hide protectionist policies. The Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT) Agreements were originally adopted by the WTO in an attempt to prevent the standards requirements that are applied in international trade settings from being utilized as a protectionist tool (Cato 1998).
The aim of the SPS agreement is to prevent the standards imposed by importing countries in an attempt to protect animal and plant life, as well as human health to be used as an unnecessary barrier to trade (Bostock et al. 2004). This agreement requires a country to adapt its national measures (with regards to food safety standards) to the international standards set by the Codex Alimentarius Commission (CAC). However, when a country can scientifically prove the need, it can establish stricter measures to protect public health. Meanwhile, the aim of the TBT agreement is to assure that the technical measures regarding standards, such as labeling, packaging and other related product quality requirements are not utilized as technical barrier to trade.

In the fish and fishery trade, increasing complex standards have been established, possibly due to increasing outbreaks of foodborne illnesses and increased consumer awareness of healthy and sustainable products (Iocovane 2003; Bostock et al. 2004). Increasing concerns that fish consumption may lead to certain health risks due to contamination of harmful substances has encouraged many countries to set tolerance guidelines for certain contaminants, such as heavy metals, dioxins, pesticides and drug residue. In order to protect public health, some countries have imposed stricter chemical standards than outlined by the CAC. Moreover, other concerns related to environmentally safe and sustainable fishing has become a significant issue that affects the fishery industry.

As an example, with the European Commission (EC) Regulation 1005/2008, the European Union attempts to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing. IUU fishing is a global problem which violates conservation and fishery management under international agreements. The regulation aims to ensure full traceability of all marine fishery products through catch certification. Other regulations regarding environmental concerns within the tuna trade have been created by the United States through the dolphin safe label being printed on tuna cans in order to encourage fisheries to avoid dolphin by-catch during the tuna fishing process. To determine the different standards required by importing countries affecting trade, standards are categorized into four categories (as described in previous section). Table 6 below summarizes the minimum standards set by several importing countries and its categories.

Table 6  List of Standards Imposed by Importing Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Standards Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Union (EU)</td>
<td>• Maximum residual limits (MRLs) of chemical contaminants and pesticide residue, including heavy metals (Cadmium, Lead and Mercury) through Directive 2001/22/EC and EC No 1881/2006, veterinary drugs and pesticide residue and histamines through Directive 91/493&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• In 2002, the EU established regulation Minimum Residual Performance Limits (MRPLs) which specified minimum concentration levels of detectable residue&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Traceability of all marine products through catch certificates (EC 1005/2008), effective since 2010. The aim of this regulation is to combat IUU fishing&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Country</td>
<td>Standards Requirements</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| United States (US) | - Maximum residual limits of chemical contaminants and pesticide residue, including heavy metals (Cadmium, Lead, Arsenic and Mercury), pesticide residue and histamines through US Food and Drug Administration
d
|               | - In 1998, HACCP became mandatory for importing to the US                                   |
|               | - Dolphin safe label (2013)                                                             |
|               | - Similar case with EU, since the beginning of this study, the US has applied national standards which mean it standards categories is 1 since 2000. In 2013, the US standards shift into category 3 since dolphin safe label required in order to export to the US |
| Japan         | - Maximum residual limits of chemical contaminants and pesticide residue, including heavy metals (Mercury and methylmercury), PCB, veterinary drugs, antioxidants, colouring and bleaching agents under Food Sanitation Law\[^a,b,c\] |
|               | - The Food Safety Basic Law (FSBL) was established in 2003 to restrict substances without MRLs to zero tolerance\[^a\] |
|               | - Japan has applied national standards since the beginning of this study which imply it standards categories is 1 since 2000. In 2003, the FSBL applied so that Japan standards shift into category 2 |
| Australia     | - Maximum residual limits of chemical contaminants and pesticide residue, including heavy metals (Antimony, Arsenic, Cadmium, Copper, Lead, Mercury, Nitrates, Polychlorinartenit Biphenyls, Selenium, Tin, Zinc, Phosphates and Sulphur Dioxide) under the Imported Food Control Act of 1992\[^e\], so that the Australia standards is categorized into 1 since the beginning of the study |
| Egypt         | - Maximum residual limits of chemical contaminants and pesticide residue according to CAC standards\[^e\] |
|               | - Egypt applied CAC standards (international standards) which imply it standards is categorized into 0 since the beginning of this study |
| Saudi Arabia  | - Maximum residual limits of chemical contaminants and pesticide residue according to CAC standards\[^e\] |
|               | - Similar with Egypt, Saudi Arabia applied CAC standards (international standards) which imply it standards is |
Table 6  List of Standards Imposed by Importing Countries (continued)

<table>
<thead>
<tr>
<th>Country</th>
<th>Standards Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>categorized into 0 since the beginning of this study</td>
</tr>
<tr>
<td>Canada (continued)</td>
<td>Maximum residual limits of chemical contaminants and pesticide residue, including heavy metals (lead, arsenic and mercury), veterinary drugs, pesticides and histamines through The Fish Inspection Act (R.S.C.1985 c.F.-12) and The Fish Inspection Regulations (C.R.C1978c 802)(^{e}), so that the Canadian standards is categorized into 1 since the beginning of the study</td>
</tr>
</tbody>
</table>

Source: Author’s compilation with information from "Nguyen& Wilson (2009), "Ababouch et al. (2005), "SEAFDEC (2008), "GAIN USDA and "CFIA

When exported fish products do not meet the standards requirements of the target market, the shipment can be rejected, destroyed or detained (Ababouch et al. 2005). As a result, the exporter will experience economic losses.

Factors Affecting Trade Flows of Canned Tuna

In this study, the trade flow of canned tuna from Thailand, the Philippines and Indonesia can be explained by several variables, specifically total canned tuna production by exporting countries, GDP of importing countries, remoteness of exporting countries, exchange rates, dummy of free trade agreement and dummy of food standards. Total production, GDP, exchange rates and free trade agreement are variables that are predicted to support trade while remoteness and food standards are variables that are predicted to hinder trade. The descriptive statistics of the estimations are presented in Table 7.

Table 7  Summary and Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade value</td>
<td>2100</td>
<td>1.11e+07</td>
<td>3.70e+07</td>
<td>0</td>
<td>5.77e+08</td>
</tr>
<tr>
<td>Canned tuna production</td>
<td>2100</td>
<td>201107.7</td>
<td>224465.8</td>
<td>30768</td>
<td>856708.6</td>
</tr>
<tr>
<td>GDP of importer country</td>
<td>2100</td>
<td>8.03e+11</td>
<td>2.05e+12</td>
<td>3.92e+09</td>
<td>1.68e+13</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>2100</td>
<td>1942.42</td>
<td>4244.049</td>
<td>0.014</td>
<td>29328.63</td>
</tr>
<tr>
<td>Remoteness</td>
<td>2100</td>
<td>3.75e+08</td>
<td>3.29e+08</td>
<td>5.34e+07</td>
<td>1.26e+09</td>
</tr>
<tr>
<td>Participation in FTA</td>
<td>2100</td>
<td>0.064</td>
<td>0.245</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Standards 1</td>
<td>2100</td>
<td>0.23</td>
<td>0.421</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Standards 2</td>
<td>2100</td>
<td>0.253</td>
<td>0.435</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Standards 3</td>
<td>2100</td>
<td>0.134</td>
<td>0.341</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration from STATA results
There are 2100 observations which contain cross section data of export value from Thailand, the Philippines and Indonesia towards 50 destination countries for 14 years. As can be seen in Table above, average trade value is US$11.1 million. The lowest trade value is US$0, where there is no trade occurred between partner countries at a certain time period. In this study, as much 441 observations or 21% of the total observations has zero trade value. The highest trade value is US$577 million, which is export value from Thailand to the USA in 2012. Figure 13 showed the development of canned tuna export from Thailand, the Philippines and Indonesia for 14 years, 2000 to 2013, which including in data set for this study. As can be seen in Figure 13 below, canned tuna export experienced an increasing growth at most year of observations and slightly declining in 2003 and 2009.

As showed in Table 7, average production of tuna is 201107.7 MT, with the lowest production is 30768 MT (the Philippines production in 2005) while the largest production is 856708.6 MT (Thailand production in 2013). Tuna production growth of Thailand, the Philippines and Indonesia can be seen in Figure 14. Figure below expressed an increasing on tuna production in each exporter during the observation period of this study (2000 to 2013). Thailand experienced rapid growth while The Philippines and Indonesia experienced almost similar growth in producing tuna. This situation is supported by growing canned tuna industry in each exporting countries. Currently, Thailand has developed 30 canneries with annual production 700.000MT, while the Philippines and Indonesia have 11 and 13 canneries with annual production capacity 200.000MT and 100.000MT respectively.
As written in summary and descriptive statistics, average GDP of destination countries was US$803 trillion, with the lowest GDP was US$3.92 trillion (Malta in 2001) while the highest GDP reached US$16800 trillion (the USA in 2013). Average exchange rate is US$1942.425 with the lowest value is US$0.0144161 (exchange rate Thailand baht to Columbian peso in 2003) and the highest is US$29328.63 (exchange rate Indonesian Rupiah to Maltese lira in 2007). Figure 16 below portrayed the exchange rate from local currency of exporting countries into US$ in observation periods. Thailand and the Philippines had similar movement which gradually decreased since 2004, while Indonesia showed more volatile movement.
Standards variable in this study expressed through dummy variable. As describe in the previous chapter, there are different standards imposed by importing countries. To capture how the different standards affecting canned tuna trade, this study categorize the required standards in each country into four categories. Figure 16 below portrayed the development of standards imposed by importing countries during 14 years observation period. In the beginning of the observation, export destination countries are almost divided evenly into category 0 (using international standards) and category 1 (imposing national standards). In 2002, some countries (the EU) imposed more restrictive standards by decreasing chemical contaminant and residues. In 2010 and 2013, the EU and the US required certification to access their market.

![Figure 16 The development of standards imposed by importing countries, 2000-2013](source: Author’s elaboration with data from CFIA, USDA and SEAFDEC (2008))

**Comparison of OLS and PPML Result**

The fixed effect and random effect models are two common approaches to analyzing panel data. To test whether a fixed effect or random effect model is better for explaining the gravity equation in this model, the Hausman test was applied. The result of Hausman test indicated that a fixed effect model is better-suited fit to this study (Appendix 2). Moreover, in this study, the variant across countries is assumed to be correlated with the independent variables included in the model and not random. Furthermore, taking the multilateral resistance into consideration, importer and exporter fixed effects are employed.

To analyze factors affecting the canned tuna trade from Thailand, the Philippines and Indonesia, the OLS and PPML estimation techniques were utilized. In order to obtain unbiased, efficient and consistent parameters in the OLS estimation, several basic assumptions are made, including testing for normality, multicollinearity and heteroskedasticity (Appendix 3). The normality test is conducted in order to determine whether the residuals close to a normal distribution. To check the normality of residuals, the kernel density estimation
was applied. The result showed that the distribution of the residuals follows the normal distribution. Testing for multicollinearity was applied by checking for the variance inflation factor (VIF), which showed that there are no variables with VIF values greater than 10, meaning that multicollinearity does not occur. The modified Wald test was utilized to test for heteroskedasticity, with the null hypothesis being a state of homoskedasticity (constant variance). The test result showed that the p-value is 0.000 (statistically significant), indicating that the null hypothesis is rejected, thus implying the presence of heteroskedasticity. In order to deal with the heteroskedasticity problem, the cluster and robust standard errors command are used in a regression model with STATA.

Table 8 shows the result of the OLS and PPML regressions with a fixed effect. The F-test of both regressions is less than 0.01, indicating that the independent variables in the model jointly affect the dependent variable and there is at least one coefficient of the estimated variable in the model that is not equal to zero.

Table 8 OLS and PPML Estimation Results

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>PPML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable</td>
<td>Ln Trade Value</td>
<td>Trade Value</td>
</tr>
<tr>
<td>Independent Variables:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln production</td>
<td>0.959***</td>
<td>0.653***</td>
</tr>
<tr>
<td></td>
<td>(0.144)</td>
<td>(0.093)</td>
</tr>
<tr>
<td>Ln GDPj</td>
<td>0.744***</td>
<td>0.932***</td>
</tr>
<tr>
<td></td>
<td>(0.207)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>Ln exchange rate</td>
<td>-0.089**</td>
<td>-0.274***</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.092)</td>
</tr>
<tr>
<td>Ln remoteness</td>
<td>0.025</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>FTAij</td>
<td>0.914</td>
<td>0.247**</td>
</tr>
<tr>
<td></td>
<td>(0.351)</td>
<td>(0.129)</td>
</tr>
<tr>
<td>D_standards1</td>
<td>-0.445***</td>
<td>-0.429***</td>
</tr>
<tr>
<td></td>
<td>(0.259)</td>
<td>(0.169)</td>
</tr>
<tr>
<td>D_standards2</td>
<td>-0.189</td>
<td>-0.536***</td>
</tr>
<tr>
<td></td>
<td>(0.239)</td>
<td>(0.135)</td>
</tr>
<tr>
<td>D_standards3</td>
<td>0.059</td>
<td>-0.356***</td>
</tr>
<tr>
<td></td>
<td>(0.263)</td>
<td>(0.146)</td>
</tr>
<tr>
<td>Constant</td>
<td>-14.569***</td>
<td>-15.720***</td>
</tr>
<tr>
<td></td>
<td>(4.417)</td>
<td>(2.431)</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>1648</td>
<td>2100</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.6907</td>
<td>0.9320</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration from regression results
Note: Both estimations use the importer and exporter fixed effect. The numbers in parentheses are standard errors which are calculated by cluster and robust standard errors. *significant at 10%, **significant at 5%, ***significant at 1%

The result in Table 8 above shows that the continuous variables that are statistically significant in both estimation techniques are canned tuna production, the GDP of importing countries and the exchange rate. The coefficient of
production in the OLS indicates a larger value than in the PPML estimation while the coefficient of the GDP of importing countries is smaller in the OLS estimation. Both the production and the GDP of importing countries are positive and significant at the 1 percent level. The estimated exchange rate in both estimations is negative and significant at the 1 percent level. The OLS and the PPML estimations show that standards 1 has a negative and significant effect, with both estimations showing a similar value. The remoteness variable in both estimations has an insignificant effect. Variables that are significant in the PPML estimation but insignificant in the OLS estimation are the dummy of FTA, standards 2 and standards 3.

As can be seen above, the standard errors in the PPML estimation are smaller than in the OLS estimation. Regarding the number of observations, the PPML estimation has a greater amount of observations (2,100) compared to the OLS estimation (1,648); this is due to the gravity equation in the OLS being estimated with a logarithmic form. As a result, all of the zero trade observations were dropped in the OLS estimation. The value of the R-squared in the OLS estimation is 0.6907, meaning that the model can explain 69.07 percent of the variability in canned tuna exports. The value of R-squared in the PPML, however, is higher 0.9320, indicating that the model can explain 93.2 percent of the variability of the canned tuna exports.

Taking into consideration the magnitude of the coefficients, the economic implications, the higher number of observations and the explanatory ability of the model, it is determined that the PPML estimation is the best approach for further analysis.

**Interpretation of the PPML Estimation of Canned Tuna Trade**

As describe in the previous part, PPML estimation result is used to interpret trade flows and the role of standards on canned tuna trade. This section begins with the interpretation of canned tuna production variables and the explanation regarding the regression result on how this variable influencing canned tuna trade, followed with GDP of importing countries, the exchange rate, remoteness, participation in free trade agreements (FTAs) and standards.

**A. Canned Tuna Production**

Canned tuna production has a positive and statistically significant effect at the 1 percent significance level on the value of canned tuna export; this result is consistent with the hypothesis. The estimated coefficient of canned tuna production is 0.653 which means that a 1 percent increase in the canned tuna production in the exporting countries (Thailand, the Philippines and Indonesia) will result in an increase of approximately 0.653 percent of the value of canned tuna exports in the importing countries, ceteris paribus. The relationship between the export value and canned tuna production is portrayed in Figure 17.

Figure 17 shows the average export value, as well as the total production quantity of canned tuna from Thailand, the Philippines and Indonesia from 2000 to 2013. It supports the result of the gravity estimation which states that the export value of canned tuna increases with an increase in canned tuna production. Based on the figure below, it can be predicted that both the export value and the total...
production of canned tuna are likely to increase each year. As describe in previous chapter (general overview of canned tuna industry) and descriptive statistics, the canned tuna industry in Thailand, the Philippines and Indonesia are growing rapidly. These countries experience exponential growth especially Thailand in producing canned product which are supported by development of canneries and fishing technology which imply increasing in producing capacity. As the production of canned tuna increases, the canned tuna product marketed to foreign market increases as well. Thus, it is likely that canned tuna production supported canned tuna export.

Figure 17  The average export value (Million US$) and production (thousand MT) of Thailand, the Philippines and Indonesia canned tuna, 2000-2013
Source: Author’s elaboration with data from the UN Comtrade (2013) and FAO-FishtatJ (2015)

B. GDP of Importing Countries

The GDP of importing countries has a positive and statistically significant effect on the value of canned tuna exports. The estimated coefficient of the GDP of importing countries is 0.932, which implies that a 1 percent increase in the GDP of importing countries will lead to a 0.932 percent increase in the value of canned tuna exports from the exporting countries (Thailand, the Philippines and Indonesia), ceteris paribus. This result is consistent with the theory that reflects this variable capturing the purchasing power and market size (absorptive capacity) of importing countries on the exported goods (canned tuna). It indicates that as the GDP of importing countries increases, the potential demand for canned tuna will likely increase as well.

Figure 18 showed the development of GDP from several export destination countries during observation period of this study. Almost all of main export destination countries face an increase in GDP. The USA showed highest GDP which increases for all year of observation. United Kingdom in the second position follows by Spain, Saudi Arabia and Japan. As stated above, the increasing GDP of importing countries will drive increasing demand of canned tuna in the long run due to an increase purchasing power.
C. Exchange Rate

The estimated coefficient of the exchange rate has a negative and statistically significant effect on the canned tuna export. The estimated coefficient of the exchange rate is -0.274 which implies that with a 1 percent increase in the exchange rate, the export value of canned tuna will decrease by 0.274 percent, ceteris paribus. Theoretically, an increase in the exchange rate or a depreciation of the exporting country’s currency relative to the importing country’s currency will lead to an increase in export demand from the importing country, thus it will lead the exporting country to increase the volume of export. However, the estimated result of the exchange rate in this study is not consistent with theory. Studies by Mega (2013) and Sudiyana (2014) showed similar results, that the depreciation of exchange rate does not affect export enhancement.

There are several possible reasons supporting this argument. Firstly, competitions in the world canned tuna market which force producing countries to keep maintain its position despite its currency situation. Secondly, standards as the requirements to entry foreign market play an important role. Producing countries might experience economic losses as a result of rejected, destroyed or detained of the exported products, if it product do not meet the standards requirements from the target market (Ababouch et al 2005). As standards to entry foreign market more complex, cost to comply become higher. This cost to compliance probably higher than the price exporting countries need to pay due to the different in exchange rate. Thirdly, as can be seen in Figure 10, the canned tuna export value tends to increase which means that the demand from the importing countries remains high. Even though the exchange rate of Thailand, the Philippines and Indonesia may decrease, or appreciate, the demand of the importing countries does not decrease the canned tuna export value from these countries. Moreover, the domestic demand is low (Hamilton et al 2011).
D. Remoteness

Based on the estimation results, the remoteness index is statistically insignificant, indicating that the remoteness variable does not substantially affect the canned tuna export from Thailand, the Philippines and Indonesia. This variable refers to the cost that exporters face to in order to trade (trade resistance) or as a proxy to multilateral trade resistance.

Possible reason for why this variable does not result in a significant effect on the canned tuna trade is the multilateral resistance effects seem to be adequately captured by the exporter and importer fixed effects, and that there impact does not vary too much over time. Moreover the improvement of transportation and logistics, including storage and preservation, which reduce overall transportation costs (Asche 2015). Furthermore, as canned tuna is traded in a processed form, it is canned in a way which allows the product to be stored for a long time, making transportation costs account for a relatively small amount of the final price, a characteristic of many canned products.

E. Free Trade Agreements (FTA)

The coefficient of free trade agreements (FTA) has a positive and statistically significant effect on canned tuna export. The estimation result shows that the establishment of an FTA results in an increase in the average total canned tuna export by 28.01 percent (Table 9), ceteris paribus. The establishment of regional trade agreements between Thailand, the Philippines and Indonesia with the importing countries would be an underlying reason for the positive impact of FTA to the canned tuna export.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated Coefficient</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards 1</td>
<td>-0.429</td>
<td>-53.57</td>
</tr>
<tr>
<td>Standards 2</td>
<td>-0.536</td>
<td>-70.91</td>
</tr>
<tr>
<td>Standards 3</td>
<td>-0.356</td>
<td>-42.76</td>
</tr>
<tr>
<td>FTA</td>
<td>0.247</td>
<td>28.01</td>
</tr>
</tbody>
</table>

Source: Author’s calculation

Specifically, Thailand, the Philippines and Indonesia belong to the Association of Southeast Asian Nations (ASEAN). In 2008, the ASEAN-Japan FTA was established, leading to several reductions in customs duties, including those regarding canned tuna products. The duty for canned was 9.6 percent in general, but since the ASEAN-Japan in effects, the duty from ASEAN was 9.2 percent in 2009 and gradually decreased to 7.5 percent in 2013. In Thailand case, a year before the ASEAN-Japan established, Thailand has already entered a bilateral agreement with Japan through the Japan-Thailand Economic Partnership Agreement (JTEPA), as a result, Thailand’s canned tuna products experienced lower import duty than other countries (5.3 percent in 2007) and became duty free as of 2013 (Ministry of Finance Japan 2015). Thus, it can be determined that

\[ (\exp\beta - 1) \times 100 \]
participation in an FTA will lead to a decrease in import duty, which further increases the incentive to export canned tuna.

F. Standards

Based on the estimation result, all standards have a negative and statistically significant effect on canned tuna exports. This implies that the imposition of standards by importing countries leads to a reduction in canned tuna exports. Three standards are included in the model that indicate (1) if a country imposes its national standards by taking into consideration a maximum limit of chemical contaminants and drug residues which are stricter than international standards, (2) if a country establishes more restrictive maximum limit of chemical contaminants and drug residues than it was in the previous years, and (3) if a country not only establishes maximum limit of chemical contaminants and drug residues but also requires specific certification (catch certificate and/or eco-labeling). The results indicate that the imposition of national standards generated a 53.57 percent reduction in canned tuna exports (Table 9). Moreover, when the importing country imposes stricter standards, canned tuna export decreases by 70.91 percent. Furthermore, the imposition of specific certification requirements will lead to a 42.76 percent reduction in canned tuna exports. This result is consistent with the hypothesis that indicates that standards act as a barrier to trade.

As can be seen from the result, when the country imposes stricter standards, the exporters face higher losses from the reduction of canned tuna export. The imposition of specific certification (traceability and eco-labeling) has the lowest losses. To explain how stricter standards may lead to higher losses, the increasing export rejection or border case in the European Union can be taken as an example. During 1999 to 2002, total recorded border case for fish and fishery products in the EU was 900 cases, with almost 50 percent of total border cases occurred in 2002. The tremendous increasing of border case in 2002 was majorly due to stringent testing regime on chemical risks (Ababouch et al. 2005). Canned products comprise about 6 percent of total border cases that mainly cause from chemical contaminations.

In standard 3 cases, the change in canned tuna export is lower than standard 1 and standard 2. Several reasons may cause this condition. Firstly, the requirements to provide specific certification (catch certificate and/or eco-labeling) are more recent than chemical contaminants and drug residues regulation. The EU and the US cases for example. The EU required technical standards to be able to trace imported canned tuna through catch certificates (EC 1005/2008) which effective in 2010 meaning it start in the last three years of observation period. Meanwhile, the US imposed dolphin safe label in the end of observation period, 2013 (CFIA 2015). Secondly, importing countries are willing to pay high for product with this certification. Despite having high cost to comply with this requirement, exporting countries experience high benefits. In standard 1 and 2 cases, exporting countries may face rejection which leads to economic losses, if its export does not asses the standards requirement (Ababouch et al. 2005). However in standard 3 cases, even though canned tuna does not fulfill the requirement from the EU and the US, exporter may transfer canned tuna product to other trading partners which do not require specific certification, such as Middle East countries.
Based on explanation above, it can be conclude that standards, as in food safety standards and technical requirement (eco-labeling), act as barrier on canned tuna trade from Thailand, the Philippines and Indonesia. Even though the imposition of more stringent standards by the importing countries may difficult in compliance and become main challenges, it is also giving an opportunity for Thailand, the Philippines and Indonesia if they able to overcome this problem and strengthen their position in the world canned tuna market. Moreover, despite the regression result showed that standards have negative coefficient (which may lead to reduction in export), the three exporters experienced an overall increase in export, which means Thailand, the Philippines and Indonesia are capable in fulfill the standards required by importing countries despite the differences in standards requirement.

7 CONCLUSIONS AND RECOMENDATIONS

Conclusions

This study examines trade flows and the role of standards on canned tuna from three largest exporters from Asia: Thailand, the Philippines and Indonesia. Factors that statistically significant in affecting canned tuna trade are the canned tuna production, the GDP of the importing countries, exchange rate, FTA establishment and the imposition of standards by export destination countries. Canned tuna production shows positive coefficient as well as the GDP of the importing countries and FTA establishment. These variables have positive effect on canned tuna trade or in other words may support canned tuna trade from Thailand, the Philippines and Indonesia towards export destination countries. Meanwhile the exchange rate shows negative coefficient which implies this variable may reduce canned tuna trade. Almost all of the estimation result consistent with the hypothesis except the exchange rate which shows negative coefficient and remoteness which statistically not significant. Standards variables are captured by the dummy variables which are categorized into three standards. Based on the result from the gravity analysis with PPML estimation, the imposition of stricter standards reduces canned tuna export from Thailand, the Philippines and Indonesia, which are indicated by negative coefficients and statistically significant in all standards included in the model.

Recommendations

This study shows that standards hinder trade by reducing canned tuna export from Thailand, the Philippines and Indonesia. The imposition of standards by the foreign countries is likely to stricter due to growing concern of health and environmental awareness for better-off consumers. It implies that Thailand, the Philippines and Indonesia have to prepare to comply with this requirement by increasing its national standards to increase market access. Additionally, Thailand, the Philippines and Indonesia have to widen the market to other potential export destination such as Middle East countries which demand are tend to increase.
Other suggestions, Thailand, the Philippines, and Indonesia can also engage in trade agreements with trading partners such as the EU which will lead to a reduction in import duties.

Recommendation for further research, in terms of gravity model specification, including other variables such as tariff or exchange rate of both exporting and importing countries may enrich the estimation. In regard to standards, it would be ideal to compare the impact of standards on various types of fish commodities and to specifically identify standards in order to capture a deeper explanation.
REFERENCES


Tinbergen, J. 1962. *Shaping the World Economy; suggestions for an international economic policy*.


## APPENDICES

### Appendix 1. List of Exporting and Importing Countries

#### Table A 1. List of Countries

<table>
<thead>
<tr>
<th>EXPORTERS</th>
<th>IMPORTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>Austria</td>
</tr>
<tr>
<td>The Philippines</td>
<td>Croatia</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Greece</td>
</tr>
<tr>
<td>United States of America</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>Italy</td>
<td>Chile</td>
</tr>
<tr>
<td>France</td>
<td>Malta</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>South Africa</td>
</tr>
<tr>
<td>Spain</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>Germany</td>
<td>Finland</td>
</tr>
<tr>
<td>Japan</td>
<td>Singapore</td>
</tr>
<tr>
<td>Australia</td>
<td>Ireland</td>
</tr>
<tr>
<td>Canada</td>
<td>Romania</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Mexico</td>
</tr>
<tr>
<td>Egypt</td>
<td>Cyprus</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Peru</td>
</tr>
<tr>
<td>Belgium</td>
<td>Dominic Republic</td>
</tr>
<tr>
<td>Colombia</td>
<td>Poland</td>
</tr>
<tr>
<td>Portugal</td>
<td>Malaysia</td>
</tr>
<tr>
<td>Israel</td>
<td>Sweden</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Yemen</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
</tr>
<tr>
<td></td>
<td>Algeria</td>
</tr>
<tr>
<td></td>
<td>New Zealand</td>
</tr>
<tr>
<td></td>
<td>Morocco</td>
</tr>
<tr>
<td></td>
<td>Lebanon</td>
</tr>
<tr>
<td></td>
<td>Slovakia</td>
</tr>
<tr>
<td></td>
<td>Syria</td>
</tr>
<tr>
<td></td>
<td>United Arab Emirates</td>
</tr>
<tr>
<td></td>
<td>Libya</td>
</tr>
<tr>
<td></td>
<td>Czech Republic</td>
</tr>
</tbody>
</table>

### Appendix 2. Hausman test result

Test: Ho: difference in coefficients not systematic

\[
\text{chi}^2(8) = (b-B)'(V_b-V_B)^{-1}(b-B) = 23.74
\]

Prob>|chi|2 = 0.0025

(V_b-V_B is not positive definite)
Appendix 3. The result of basic assumption testing

1. Normality of Residual

![Kernel density estimate](image)

- **Kernel density estimate**
- **Normal density**

- **Kernel**: epanechnikov, **bandwidth**: 0.3418

2. Multicollinearity

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>D_standards1</td>
<td>1.71</td>
<td>0.585375</td>
</tr>
<tr>
<td>D_standards2</td>
<td>1.68</td>
<td>0.596363</td>
</tr>
<tr>
<td>D_standards3</td>
<td>1.51</td>
<td>0.663828</td>
</tr>
<tr>
<td>lnprod</td>
<td>1.43</td>
<td>0.699567</td>
</tr>
<tr>
<td>lner</td>
<td>1.37</td>
<td>0.729449</td>
</tr>
<tr>
<td>lnremij</td>
<td>1.31</td>
<td>0.763065</td>
</tr>
<tr>
<td>FTAij</td>
<td>1.08</td>
<td>0.927282</td>
</tr>
</tbody>
</table>

| Mean VIF       | 1.39  |

3. Heteroskedasticity

**Modified Wald test for groupwise heteroskedasticity in fixed effect regression model**

- **H0**: $$\sigma(i)^2 = \sigma^2$$ for all i

  - $$\chi^2 (150) = 1.0e+06$$
  - Prob > $$\chi^2 = 0.0000$$
Khairunnisa Nur Rahmah was born on 18 December 1988, in Bandung, Jawa Barat. She is the first daughter with one younger sister from Sjamsu Chairwandhi and Anni Yuniarti family. She grew and educated in Bandung. In 2006, She was accepted in Animal Husbandry Faculty, Padjadjaran University and earned bachelor degree in animal science (S.Pt) in 2010.

In 2012, she was continued her study at Magister Science of Agribusiness sponsored by Beasiswa Unggulan - Biro Perencanaan dan Kerjasama Luar Negeri Kementerian Pendidikan Nasional for the tuition fees. In the second year of her study, she was accepted for Joint Degree Program between Magister Science of Agribusiness, Bogor Agricultural University, Indonesia and Sustainable International Agriculture, Georg-August University of Göttingen, Germany, sponsored by Beasiswa Pendidikan Pascasarjana Luar Negeri (BPPLN) Directorate General of Higher Education, The Ministry of National Education Republic of Indonesia. She was graduated from Magister Science of Agribusiness and Sustainable International Agriculture with thesis titled: "Trade Flows Analysis and the Role of Standards on Canned Tuna Trade" supervised by Dr Ir Andriyono Kilat Adhi, Dr Ir Dwi Rachmina, MSi and Prof Dr Bernhard Brümmer.