ANALYSIS OF TRADE PERFORMANCE,TRADE COSTS AND IMPACTS OF FDI AND TRADE FACILITATION ON MANUFACTURING TRADE OF THAILAND

Piya WONGPIT

(Degree)
博士（経済学）
(Date of Degree)
2014-03-25
(Date of Publication)
2015-03-01
(Resource Type)
doctoral thesis
(Report Number)
甲第6020号
(URL)
https://hdl.handle.net/20.500.14094/D1006020

October 7, 2013

ANALYSIS OF TRADE PERFORMANCE, TRADE COSTS AND IMPACTS OF FDI AND TRADE FACILITATION ON MANUFACTURING TRADE OF THAILAND

(タイの工業製品貿易に対する FDI（外国直接投資）と貿易円滑化の影響および貿易実績と貿易コストに関する分析)

Graduate School of International Cooperation Studies

Department of Economic Development and Policies

Academic Adviser: Professor Nobuaki MATSUNAGA

Student Number: 098I501I

Name: Piya WONGPIT

ACKNOWLEDGEMENTS

This paper would not have been successful without the kind support of a number of people who helped and inspired me throughout the course of my study at Graduate School of International Cooperation Studies (GSICS), Kobe University.

First of all, I would like to express my profound thanks to my supervisor Professor MATSUNAGA Nobuaki for his invaluable guidance and comments at all stages of my thesis. My heartfelt gratefulness is also extended to Professor OHTA Hiroshi who spent a lot of effort discussing my work and providing guidance and comments on every aspect of this thesis. I want to also extend my gratitude to Professor SURUGA Terukazu for giving me constructive comments and suggestions on my thesis.

In addition, I would like to thank Dr. Patricia Boyle who helped me in organizing and editing this paper. I am also thankful to the entire staff of GSICS for helping and supporting me whenever I requested assistance. My heartfelt thanks are also extended to Piyarat Pipitpanichtham for providing me necessary data for my thesis. I would like to thank all of my friends for their support and encouragement along the way of my study at GSICS.

Lastly, I extend my special thanks and love to my parents, my wife, sons and sisters for their emotional support and encouragement.

Piya Wongpit

October 7, 2013

EXECUTIVE SUMMARY

The manufacturing industry of Thailand has been the most important sector for the economic growth of the country since the 1990's. Total export of the manufacturing industry in Thailand in the 1990s and 2000s accounted for more than 90% of overall exports and its market share in the world market was around 1.2% in 2010. The country was the leader in producing and exporting manufactured products in ASEAN countries during the 1990s. The Asian financial crisis in 1997 had enormous impacts on the economy of Thailand, but not much impact on the manufacturing exports. The effect of the crisis in 1997 reduced the output of the manufacturing industry to the second largest in the ASEAN region. However, since the crisis the industry has grown continuously at an average of 12% per year.

The experience of Thailand has attracted the interest of researchers who seek to understand the performance of the manufacturing trade before and after this crisis. Many factors such as trade performance, total factor productivity and fiscal and monetary policy have been used to explain this quick recovery from the crisis. Many studies found that trade performance in the manufacturing industry was a crucial factor that pulled Thailand out of the crisis. Hence, understanding which factors affected the trade performance of the manufacturing industry of Thailand is of significant importance.

Among those factors, FDI is one that has supported manufacturing trade in Thailand for many decades. During the 1990's, Thailand's manufacturing exports were mainly concentrated in labor-intensive industries due to relatively low labor costs compared to other major trading partners. However, by the early 2000s, FDI in capital-intensive industries accounted for 60% of total FDI in Thailand, of which, about 80% was from Japan. Thus, the strength of capital-intensive industries, as well as, the exports of the manufacturing industry in Thailand were firmly established.

The market size of ASEAN is expanding significantly and Thailand has the potential to be regional distributor of foreign products. This, in part, is due to the fact that exports from source countries of FDI to ASEAN countries are relatively costly due to transportation costs,

tariffs, and other trade barriers. Source countries can utilize tariff preference and reduce trade costs by establishing firms in Thailand. For this reason, trade costs have become a significant factor in attracting FDI into Thailand.

With the focus on international trade, the issue of trade costs naturally becomes more important. The improvement of international trade in recent years has been influenced by the reduction of trade costs. The intention of international trade is to minimize trade costs through optimal tariffs, trade facilitation and trade logistics, both inbound and outbound. Recent evidence indicates that tariffs have been reduced in line with improvements of trade facilitation. Therefore, the reduction of trade costs including tariff costs and trade facilitation must benefit the manufacturing exports of Thailand.

This study has three main objectives. The first objective is to analyze the trade performance of the manufacturing industry during 1990-2010, and to examine the patterns of comparative advantage by focusing on the role of capital-labor intensity. The second objective is to investigate the impacts of FDI on the manufacturing exports and imports of Thailand during 1999-2010 by using the augmented gravity model. The final objective of this study is to estimate trade costs in the manufacturing industry between Thailand and its trading partners and to determine the impact of trade facilitation on the manufacturing exports by Thailand.

In order to accomplish the objectives of this study, various methods are applied. In analyzing the trade performance of the manufacturing industry of Thailand, trade indicators such as exports and imports share, market power index, growth rate of exports and imports are employed. Six Revealed Comparative Advantage (RCA) indices including Balassa's RCA (BRCA), Symmetrical RCA (SRCA), Weighted RCA (WRCA), Addictive RCA (ARCA), Normalized RCA (NRCA), and Michelaye's RCA (MRCA) are compared and one is selected as a benchmark to study the patterns of comparative advantage of manufacturing trade in Thailand. In addition, the roles of capital and labor in the manufacturing trade of Thailand are investigated.

Three directions of impact of FDI on manufacturing trade in Thailand are investigated through the augmented gravity model. The first direction is the impact of FDI on the manufacturing exports from Thailand to source countries of FDI. The second direction is the impact of FDI on the manufacturing exports from Thailand to other countries. The third direction is the impact of FDI on the manufacturing imports of Thailand. In addition, the exchange rate, tariffs, and crisis are also incorporated into the augmented gravity model to investigate the impacts of these factors on the manufacturing exports and imports by Thailand.

The comprehensive trade costs of the manufacturing industry of Thailand and its trading partner countries are estimated from the model of Chen and Novy (2009) based on the international trade and intra-national trade data. The comprehensive trade costs are compared across countries and over time. Then, the comprehensive trade costs are decomposed into their components in order to find the contribution of each component to trade costs. After that, the impact of trade facilitation on the manufacturing exports by Thailand is addressed by using the augmented gravity model.

The result of the trade performance of the manufacturing industry suggests that the manufacturing exports by Thailand were mainly concentrated in the labor-intensive industries such as the manufacture of products 181, 191 and 192. However, the role of capital-intensive goods has become more important in recent years since the share of the manufacture of products 241 and 341 moved from ranks lower than tenth place to the fifth and the third ranks, respectively. The comparison of six RCA indices implies that SRCA has the highest correlation between the values of the index and its ranking. The manufacturing industry is classified into four groups based on capital and labor intensity. High capital-intensive industries have increased in comparative advantage while the high labor-intensive industries have decreased in comparative advantage in the 2000s. The regression result of capital and labor on net export (export minus import) reconfirms that Thailand had comparative advantage in labor-intensive industries in the 1990s, but by the 21st century, many of these industries lost their comparative advantage.

The impact of FDI on the manufacturing exports from Thailand to source countries suggests that vertical investment or production fragmentation reduces the role of the manufacturing industry in the source countries. FDI can utilize raw material, intermediate goods, most of parts and components product in the production process by using local suppliers which are located in Thailand. FDI has a positive impact on the manufacturing exports from Thailand to other countries which indicates that FDI is invested in Thailand in order to utilize the factors of production. From this result, it can be confirmed that Thailand is an export platform for foreign firms. FDI complements the manufacturing exports from the source countries to Thailand. In other words, FDI increases the manufacturing imports to Thailand. The foreign investors not only invest but also bring some machinery which is not produced in Thailand from their home countries to Thailand.

The results of comprehensive trade costs show that the manufacturing trade costs between Thailand and its trading partners have continually decreased over time due to the reduction of tariff costs and non-tariff costs. The manufacturing trade costs between Thailand and Singapore are the lowest while trade costs between Thailand and Japan, the most important trading partner of Thailand, are the third lowest. On the other hand, the manufacturing trade costs between Thailand and the EU are relative high due to distance. In the study, the manufacturing trade costs were broken down into their components. Distance accounts for the highest proportion of trade costs and remains to be the main barrier to international trade. Trade facilitation, such as number of documents and time involved in exporting and importing, has also been an important factor associated with trade costs. This factor has had a strong impact on the manufacturing exports by Thailand and has become a more important component of that trade. The results of this study are robust and exhibit consistency with previous studies that have found that the improvement of trade facilitation enhances the manufacturing exports by Thailand.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AFTA	ASEAN Free Trade Area
ARCA	Addictive Revealed Comparative Advantage
ASEAN	Association of South East Asian Nations
AvW	Anderson and van Wincoop
BOI	Board of Investment
BRCA	Balassa’s Revealed Comparative Advantage
CBTA	Cross Border Trade Agreement
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales (Institute for Research on the International Economy)
CMT	Cut, Make, and Trim
EU	European Union
FDI	Foreign Direct Investment
FOB	Free on Board
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GMS	Great Mekong Sub-region
ISIC	International Standard Industry Classification
JPY	Japanese Yen
LRCA	Lafay’s Revealed Comparative Advantage
MRCA	Michelaye’s Revealed Comparative Advantage
NRCA	Normalized Revealed Comparative Advantage
NSO	National Statistics Office
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squared
RCA	Revealed Comparative Advantage

R&D	Research and Development
SRCA	Symmetrical Revealed Comparative Advantage
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conferences on Trade and Development
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
USA	United States of America
USD	United States Dollar
WITS	World Integrated Trade Solution
WRCA	Weighted Revealed Comparative Advantage

CHAPTER I: INTRODUCTION

1.1 Background of the Study

Thailand, like many countries in the world, heavily depends on trade. The exports and imports of Thailand constitute about 70% and 60%, respectively, of Gross Domestic Product (GDP) in recent years. The country shifted from import substitution in the early 1970s to export promotion in the late 1980s, and since then trade has contributed extensively to economic growth of the country. The manufacturing industry of Thailand is the most important sector in the economic growth of the country. The manufacturing industry contributed to 30% and 40% of GDP in the 1990s and 2000s, respectively. In addition, the total export of the manufacturing industry in Thailand covers more than 90% of overall exports and its market share in the world market was around 1.2% in 2010.

Thailand was one of the leading producers and exporters of manufactured products in the Association of South East Asian Nations (ASEAN) countries during the 1990s. The country experienced one of the fastest growth rates of the manufacturing exports among Asian economies at that time. The average growth rate of the manufacturing exports was approximately 20% per year. In 1997, the Asian financial crisis had enormous impacts on the economy of Thailand, but not much on the manufacturing exports. The effect of the crisis in 1997 dropped the output of the manufacturing industry to the second largest in the ASEAN region. However, since the crisis, it has grown continuously at an average of 12% per year. The experience of Thailand has attracted the interest of researchers on understanding the performance of manufacturing trade before and after the crisis.

After the crisis in 1997, the manufacturing industry recovered faster than the Thai government had predicted. For this reason, many studies such as Athukorala and Suphachalasai (2004), Phan (2004), and Vimolsiri (2010) attempt to explain which factors shifted Thailand out of the crisis. These authors apply factors such as trade performance, total factor productivity and fiscal and monetary policy to explain this quick recovery.

Although they reach a variety of conclusions, they all agree that the crucial factor that pulled Thailand out of the crisis was the performance of manufacturing trade. Hence, the interesting issue is to determine which factors affect trade performance of the manufacturing industry in Thailand.

Among those factors, Foreign Direct Investment (FDI) is one that has supported manufacturing trade of Thailand for many decades. Japan, the most important investor in Thailand, started to invest in the late 1980s. However, it lost its export competitiveness due to the impact of the Plaza Accord in 1985. The Japanese Yen (JPY) appreciated from 250 JPY/USD in 1985 to 120 JPY/USD in 1988, which had a massive impact on the exports of Japan. Therefore, many Japanese firms had to diversify their production locations into other countries in order to maintain their export competitiveness. The investment environment of Thailand was welcoming to foreign firms, especially in labor-intensive industries such as textile and garment industry, food industry and wood processing industry. Therefore, FDI from Japan to Thailand increased dramatically during the early 1990s.

Thailand's manufacturing exports were mainly concentrated in labor-intensive industries during the 1990s because the labor costs were relatively lower compared to other partner countries. However, the labor-intensive industry could not maintain their competitiveness in the long term. Therefore, the Government of Thailand made concentrated efforts to promote the capital-intensive industries by improving the investment environment by developing skilled labor, investing in infrastructure as well as implementing investment promotion policies. These improvements brought global FDI to Thailand, especially from Japan. In the early 2000s, FDI in capital-intensive industries accounted for 60% of total FDI and about 80% of was from Japan. Thus, the solidity of capital-intensive industries, as well as, the exports of the manufacturing industry in Thailand is firmly established.

Many foreign firms establish their factories in Thailand in order to use them as a production base. The reason is that the market size of ASEAN is expanding significantly and Thailand has high potential to be a local distributor of foreign products in this region. In addition, exports from source countries to ASEAN countries become costly due to transportation costs, tariffs, and other trade barriers. In other words, source countries lose their competitiveness if trade costs are relatively high. Source countries can utilize tariff preference and reduce trade cost by establishing firms in Thailand. For this reason, trade costs have become a significant factor attracting FDI into Thailand.

The issue of trade costs naturally becomes more important in recent discussions. Trade costs refer to all costs that occur during the shipment of products from exporter to importer including transportation costs (freight cost and time cost), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail) (Anderson and van Wincoop, 2004). The improvement of international trade in recent years has been influenced by the reduction of trade costs. Anderson and van Wincoop (2004) estimate trade costs equivalent to ad valorem tariff for industrialized countries to be 170%[1]. This number breaks down as follows: 21% for transportation costs, 44% for border related trade barriers costs and 55% for retail and wholesale distribution costs.

The intention of international trade is to minimize trade costs through optimal tariffs, trade facilitation and trade logistics, both inbound and outbound. Recent evidence indicates that tariffs have been reduced on average to lower than 5% for developed countries and 10-20% with a few exceptions for developing countries (Anderson and van Wincoop, 2004). In addition, many countries attempt to reduce trade costs by improving trade facilitation where it is defined according to the World Trade Organization as "the

[1] 1.7 = (1.21*1.44*1.55) - 1

simplification and harmonization of international trade procedures" that are "activities, practices and formalities involved in collecting, presenting, communicating and processing data required for the movement of goods in international trade" (UNESCAP, 2002, p.1).

Trade facilitation includes five components: legal and institutional framework, trade and customs documentation, cargo clearance by customs and related agencies. For example, sanitary, phyto-sanitary and health authorities, trade logistics and supply chains and trade finance (UNESCAP, 2002). According to the World Bank (2013), many developing countries have continued to develop trade facilitation and infrastructure in such areas as road, seaport and airport construction has improved. Furthermore, the customs documentation for such procedures and lead times has been dramatically reduced.

As an emerging economy in international trade, Thailand depends heavily on trade and the Government of Thailand therefore has been attempting to eliminate all trade barriers. Since manufacturing trade share is about 90% of total trade, related costs must play a significant role in manufacturing trade in Thailand. The overall tariff rate in Thailand has been reduced since the country joined ASEAN Free Trade Area (AFTA) in 1992 and signed bilateral trade agreements with many countries. In addition, the Government of Thailand has improved infrastructure and trade facilitation in recent years. Therefore, the reduction of trade costs, including tariff costs and trade facilitation, should benefit the country's manufacturing exports.

1.2 Objectives of the Study

The study of the three issues mentioned in the previous section has not been fully analyzed in the case of the manufacturing industry in Thailand. Therefore, this study investigates three of the components in the manufacturing industry's growth: (i) trade performance, (ii) impacts of FDI on manufacturing trade, and (iii) trade costs and impacts of trade facilitation on the manufacturing exports. The first objective is to analyze the trade performance of the manufacturing industry during 1990-2010. To do that, various trade indicators are estimated for all product groups under the manufacturing industries. In addition, six comparative advantage indices are calculated in order to compare and select one index as a benchmark to analyze the performance of manufacturing trade of Thailand. Then, patterns of comparative advantage are analyzed by focusing on the role of capital and labor intensity. The second objective is to investigate the impacts of FDI on the manufacturing exports and imports of Thailand during 1999-2010 by using the augmented gravity model. The final objective of this study is to estimate trade costs incurred by the manufacturing industry in trading between Thailand and its trading partners; and analyze the impacts of trade facilitation on the manufacturing exports by Thailand. This is done, by the employment of the trade costs model of Chen and Novy (2009) and the augmented gravity model to manufacturing trade of Thailand and its trading partners.

This study attempts to answer the research questions in line with the objectives of the study. With regards to trade performance of the manufacturing industry in Thailand the questions are set as follows: What has been the trade performance of the manufacturing industry during the 1990s and 2000s? Which product groups of the manufacturing industry in Thailand had a strong or weak performance? Which product groups have increased or decreased in comparative advantage? And, what are the roles of capital and labor intensity on the patterns of comparative advantage of the manufacturing industry in Thailand? Then, the study of the capital and labor intensity and patterns of comparative advantage is linked to the study of impacts of FDI on the manufacturing exports and imports in Thailand which leads to the following questions. What is the impact of FDI on the manufacturing exports from Thailand? What is the relationship between FDI and the manufacturing imports by Thailand? How do the exchange rate, tariff, and the global financial crisis in 2007 impact the manufacturing exports and imports by Thailand? The last part of this research addresses the role of trade cost and trade facilitation on the manufacturing industry in Thailand. Therefore, the questions on trade costs and trade facilitation are derived as follow: How much are trade costs between Thailand and its trading partners? What are the trends of trade costs of Thailand and its trading partners? Which components of trade costs are the most important? And, what are the impacts of trade facilitation on the manufacturing exports by Thailand?

1.3 Scope, Uniqueness, and Significance of the Study

Trade performance in this paper pays more attention to the manufacturing exports since Thailand relies heavily on income from them. However, many import indicators will be used to support the trade performance of the manufacturing industry when necessary. To analyze trade performance, this study uses data of the manufacturing industry at product group level. The product group level is the three digit level classification of the International Standard Industry Classification (ISIC). The data include 57 product groups from manufacture of processing and preservation of meat, fish, fruit, vegetables, oils and fats (151) to manufacture goods not classified elsewhere in other groups (369). The study of trade performance covers the periods from 1990 to 2010. The study of capital-labor intensity and pattern of comparative advantage uses the cross sectional data of the manufacturing industry in 1996 and 2006.

For the impacts of FDI on the manufacturing exports and imports by Thailand, panel data of 22 trading partners during 1999-2010 are used for the study. The selection of these trading partners is based on two criteria, namely, the volume of trade and availability of data covering all the variables. The volume of trade of 22 trading partners covers more than 90% of total trade in Thailand and the data of FDI in the manufacturing industry in Thailand is available for only those 22 countries. For the study on trade costs of the manufacturing industry, 24 trading partners during 1999-2010 are selected. However, for the study on the impacts of trade facilitation on the manufacturing exports of Thailand 23 trading partners are selected for the period 2005-2010 since the data of trade facilitation is only available from 2005 to 2010.

This paper provides alternative results for the three issues of manufacturing trade of Thailand as mentioned earlier. First, although there are some studies about the trade performance of Thailand, most of the studies were carried out either before or shortly after the Asian financial crisis in 1997. This study provides more recent information and detailed analysis and discussion of the problems in previous methods of analyzing trade performance. In addition, this paper is the first to analyze the trade performance of the manufacturing industry of Thailand using various Revealed Comparative Advantage (RCA) indices. RCA indices are used to analyze manufacturing trade in many aspects such as classifying industries with comparative advantage and comparative disadvantage, trend of industries, and comparing across industries. This study also emphasizes the role that capital and labor intensity played on the pattern of comparative advantage of the manufacturing industry of Thailand, which has not been done previously.

Secondly, despite the fact that the impacts of FDI on manufacturing trade are discussed in the previous studies, the scope and methodology are different in this paper. This study is the first to focus on manufacturing trade in Thailand. Three directions of impacts of FDI on the manufacturing exports and imports are discussed while in previous studies cover only the impact of FDI on export from host to source countries. Thirdly, despite the fact that comprehensive trade costs were already estimated in Arvis et al. (2012), there are many missing values due to the lack of data. This paper re-calculated the comprehensive trade costs by using a different dataset and concentrated more on the manufacturing trade costs between Thailand and its trading partners. The study of the impacts of trade facilitation on the manufacturing exports by Thailand is a new contribution to the international trade research because of the unique variables used.

Analyzing the trade performance of Thailand reveals new information about the manufacturing trade of Thailand such as the past and current situation, strengths and weaknesses, and its position of trade in the world market. The study on the impact of FDI on the manufacturing trade of Thailand provides better understanding as to why the manufacturing trade of Thailand performed well in the 2000s. The analysis of trade costs of Thailand and its trading partner countries reveals how much the trade costs between Thailand and its trading partners are and the significant components of that total trade costs. Thus, with such information, Thailand and its trading partners could reduce unnecessary trade costs through trade negotiations. The neighboring countries such as Cambodia, Lao People Democratic Republic and Myanmar that have recently opened their economies to the world market can learn from the experience of the manufacturing trade industry of Thailand. Policy makers can utilize the results of this study to create appropriate trade policies to improve the competitiveness of the manufacturing exports from Thailand. The result of this paper also can be a background for research in the international trade area in order to extend the methodology and scope of future studies.

1.4 Structure of the Study

This research is divided into seven chapters. Chapter I introduces the background, objectives of the study, its scope, uniqueness and significance.

Chapter II includes three sections. Section 2.1 reviews the previous studies related to trade performance, comparative advantage, and the roles of capital-labor intensity on patterns of comparative advantage. In section 2.2, theory and studies related to impacts of and FDI on manufacturing trade at international level and country level are summarized. In section 2.3, theory and studies of trade costs and impacts of trade facilitation on the manufacturing exports are discussed. The purpose of the research is to fill existing gaps and the discussion is present at the end of each section.

Chapter III gives details on the methodology and data used in this research. It comprises three sections, namely trade performance indicators, augmented gravity model, and trade costs. Firstly, section 3.1 explains trade performance indicators and various RCA indices and a method to compare the RCA indices. The method to analyze the role of capital and labor intensity on the manufacturing trade is also discussed in this section.

Secondly, section 3.2 presents the augmented gravity model to analyze the impacts of FDI on manufacturing trade of Thailand. Thirdly, section 3.3, the trade costs model of Chen and Novy (2009) is introduced and the method of decomposition of trade costs is discussed.

Chapter IV presents the results of trade performance indices such as export and import growth, export and import share, market power index, and various RCA indices. The comparison of six RCA indices is presented by using a non-econometric approach. The manufacturing industries are classified into four groups based on capital-labor intensity in order to analyze the pattern of comparative advantage in section 4.1. In addition, the factors determining the comparative advantage of the manufacturing industry are presented in section 4.2. The results are discussed in section 4.3.

Chapter V shows the results of the impact of FDI on manufacturing trade of Thailand. There are two sections, with section 5.1 presenting the results and section 5.2 the discussion of those results. The impact of FDI on the manufacturing trade is investigated in three directions. The first and second directions are the impact of FDI on the manufacturing exports from Thailand to the source countries and from Thailand to other countries, respectively. The third direction is the impact of FDI on the manufacturing imports of Thailand from source countries.

Chapter VI provides details of the results and discussions of the comprehensive trade costs and decomposition of trade cost. This chapter includes three sections. Section 6.1 presents the results of manufacturing trade costs between Thailand and each of its trading partners. The comparison of trade costs across countries and over time is revealed. Section 6.2 shows the results of decomposition of trade costs. Section 6.3 demonstrates the results of the impacts of trade facilitation on the manufacturing exports by Thailand.

Chapter VII summarizes the main results from Chapter IV to Chapter VI in section 7.1. Section 7.2 then provides policy implications. Finally, section 7.3 discusses some limitations and suggestions for further study.

CHAPTER II: REVIEW OF THE LITERATURE

This chapter reviews previous theories and existing studies relating to the three main topics of this research. Section 2.1 provides a brief summary of existing theories and studies on trade performance, capital and labor intensity and patterns of comparative advantage of the manufacturing industry in Thailand. Section 2.2 presents the previous literature on the impacts of FDI on trade of various countries and especially Thailand. Section 2.3 explains the theoretical concepts of the Chen and Novy (2009) trade costs model. The empirical studies of trade costs and the impacts of trade facilitation on manufacturing trade of many countries are also reviewed. The end of each section discusses the unique contributions of this research.

2.1 Review of the Literature on Trade Performance, Capital and Labor Intensity and Patterns of Comparative Advantage in the Manufacturing Industry in Thailand

Trade indicators are continually being developed for analyzing national and regional trade performances. Today, there are many trade performance indicators available for international trade analysis. Although some trade indicators are simple and easy to calculate, they are nevertheless useful for understanding the previous and current situation of a particular country's trade. UNESCAP (2007) summarized all useful trade indicators for trade policy making in its handbook of trade statistics. The handbook provides many indicators to analyze trade performances in various dimensions from the simplest ones to the most complicated ones.

One trade indicator that many countries apply to check their trade performance is RCA. Balassa (1965) utilized the concepts of comparative advantage to develop the Balassa's RCA index (henceforth BRCA). A country estimates the BRCA index in order to check the strength and weaknesses of an industry in terms of export. The BRCA index, however, has shortcomings for comparison across countries, among industries and over time. After that, many RCA indices, i.e., Symmetrical RCA (henceforth SRCA), Weighted RCA (henceforth WRCA), Addictive RCA (henceforth ARCA), Normalized RCA (henceforth NRAC) and Lafay RCA (henceforth LRCA) were developed to overcome the limitations of BRCA.

Sanidas and Shin (2010) compared six RCA indices including BRCA, SRCA, WRCA, ARCA, NRCA and LRCA by using theoretical concepts and empirical analysis. They found that none of them satisfy the theoretical concepts of comparative advantage since the notion of comparative advantage usually takes into account autarkic variables, such as autarkic relative prices and autarkic production costs, which are not observable. They calculated and compared six RCA indices for nine East Asian countries, industries and times. They found different results when using non-econometric comparative analysis and econometric comparative analysis. The results suggest that there is no perfect RCA index and each index has advantages and disadvantages depending on the ways of using it. However, NRCA seems to be the ideal RCA index when comparing across industries and over time. Bebek (2012) evaluated six RCA indices to identify the ideal measure based on statistical and empirical evidence. Statistical evidence suggests that none of them are quantifiable for all statistical properties. That is, they neither have stable mean nor symmetry. The empirical evidence suggests that the normalized variants of multiplicative RCA (BRCA and SRCA) are more consistent and robust than additive RCA (ARCA and NRCA).

In the case of Thailand, the studies on trade performances of the manufacturing industry are summarized as follows. Maule (1996) evaluated AFTA from the perspective of Thailand as to whether AFTA would enable trade creation or trade diversion. Trade creation occurs when AFTA leads to a shift in products origin from a member country whose resource costs are higher to another member country whose resource costs are lower. Trade diversion occurs when there is a shift in products origin from a non-member country of AFTA whose resource cost are lower to a member country whose resource costs are higher. The author used BRCA and the Import RCA for five ASEAN member countries during 1991-1992. The high degree of competition among ASEAN member countries suggests that they have similar patterns of comparative advantage. This result implies that there is a possibility of trade creation from the formation of AFTA. Arwatchanakarn and Srisangnam (2009) compared BRCA of Thailand and Indonesia during 2005-2009 using data of exports at the two digit level. The finding shows that the product groups of Thailand have more comparative advantage than those of Indonesia. These include machinery and equipment, foods and livestock, and chemical and related products. On the other hand, Indonesia has more comparative advantage than Thailand in crude mineral and mineral fuel products.

The next question regarding the comparative advantage is what factors influence the comparative advantage of a nation. The basic explanation is the factor intensity of the country. The theory of factor intensity and comparative advantage was developed by Heckscher and Ohlin in the 1930s. Two countries and two factors, capital (K) and labor (L), are the main assumptions of this model. Salvatore (2007) explained the link between factor intensity and comparative advantage of the Heckscher-Ohlin (H-O) model as follows:

> Tastes and the distribution in the ownership of factors of production (i.e., the distribution of income) together determine the demand for commodities. The demand for commodities determines the derived demand for the factors required to produce them. The demand for factors of production, together with the supply of factors, determines the price of factors of production under perfect competition. The price of factors of production, together with technology, determines the price of final the final commodity. The difference of relative prices between the countries determines the comparative advantage and pattern of trade (i.e., which nation exports which commodity) (Salvatore, 2007, p.132).

The conclusion from the H-O model is that "a country will export the commodity that uses relatively intensively its relatively abundant factor of production, and it will import the good that uses relatively intensively its relatively scarce factor of production" (Appleyard, et.al, 2010, p.135).

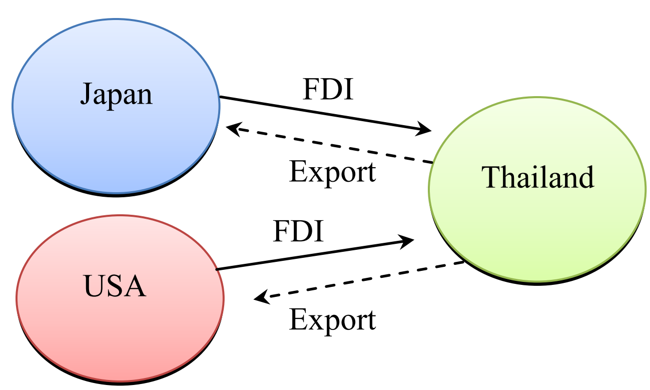
The theory of the H-O model has been applied in many empirical studies. Leontief (1956) used the input-output table to estimate the factor requirement for the export and import of the United States. A rich in capital country like the United States should export capital-intensive goods and import labor-intensive goods. However, the result was surprising that the United States mostly exported labor-intensive goods and imported capital-intensive goods. This result is known as "Leontief's Paradox." The Leontief Paradox was reconfirmed by Baldwin (1971) and Hufbauer (1970) with more recent data from the United States. However, the Leontief Paradox was rejected by many authors. Harkness and Kyle (1975) studied the factors influencing the United States' comparative advantage. They used the multi-factors regression to explain the net export of the United States. They found that the United States actually exported skilled labor-intensive goods and imported capital and unskilled labor-intensive goods. Branson and Monoyios (1977) reconfirmed the studies of Harkeness and Kyle.

The previous studies are different from one to another in terms of the scope and methodology. Most of them use the BRCA to analyze the comparative advantage of Thailand. However, it is argued that the BRCA index cannot be compared across countries, among industries and over time. This paper evaluates six RCA indices by using a non-econometric analysis. One will be selected to use as a benchmark for analyzing the manufacturing trade of Thailand. Then, the classification of comparative advantage based on capital and labor intensity is proposed in order to capture the patterns of comparative advantage. In addition, the paper applies the model of Branson and Monoyios (1977) to analyze factors determining the manufacturing trade. The model emphasizes the roles of capital and labor on net export (export minus import) of the country. The result of this approach answers the question of which factors have influenced the comparative advantage of Thailand during the 1990s and 2000s.

2.2 Review of the Literature on Impacts of FDI on Trade

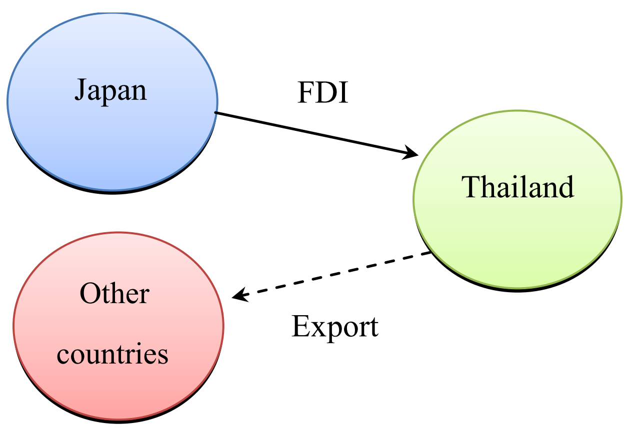
Kojima (1982) clearly indicates that FDI has two directions of impact on the export of a host country. In the first direction, FDI increases the export from the host country to the source countries. FDI increases the export from the host country to the source country when it has vertical investments which can be defined as foreign firms investing abroad to produce intermediate input that will be used in final production in their home country (Helpman, 1984). On the other hand, there is a case where FDI reduces the export from the host to the source country when the foreign firms establish the full process of production in the host country. As a result, it is not necessary to re-import the intermediate products to the home country. The impacts of FDI on the export of a host country to source countries are illustrated in Figure 2.1. In this situation, Japan and the USA are source countries while Thailand is the host country of FDI. FDI impacts the export from Thailand to Japan and the USA.

Figure 2.1 Impacts of FDI on export from Thailand to source countries



In the second direction, FDI increases the export from the host country to other countries. FDI increases the export from the host country to other countries when the source countries utilize the host country as a production base. In other words, the host country is the export platform for foreign investors due to the location advantage, low cost of production factors and transportations, and availability of natural resources. However, in the rare event that FDI decreases the export from the host to other countries, it occurs when the export from the host country to source country crowds out the export from the host country to other countries. The second direction of the impact of FDI on the export of Thailand is shown in Figure 2.2. In this situation, Japan invests in Thailand in order to export to other countries.

Figure 2.2 Impact of FDI on exports from of Thailand to other countries

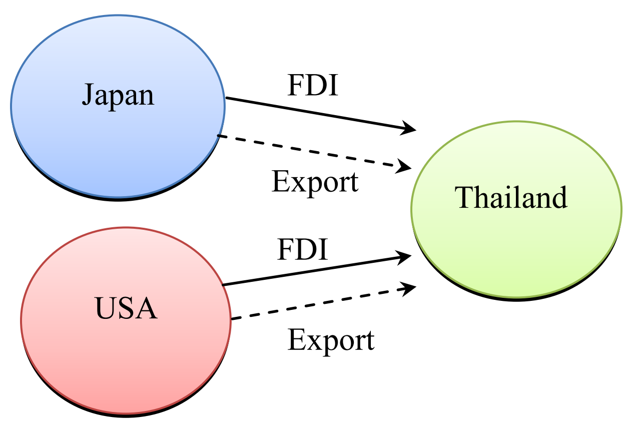


Many empirical works on the impacts of FDI on export are discussed across countries and a particular country. Chaisrisawatsuk and Chaisrisawatsuk (2007) investigate the interaction of trade and FDI of 29 OECD and 6 ASEAN countries during 1980-2004. They apply the augmented gravity model to test the link between trade and FDI. The results indicate that FDI increases the export from the host countries to source countries while it decreases the export from the host countries to other countries. Liu, Wang and Wei (2001) apply the Granger causality test to analyze the relationship between trade and FDI in China during 1984-1998. The positive impacts of FDI on import and export suggest that

FDI complements the trade of China. Xuan and Xing (2006) use the augmented gravity model to analyze the impact of FDI on the exports of Vietnam. The results clearly indicate that FDI has a positive impact on exports from Vietnam to source countries.

The discussions of the relationship of FDI and trade also concentrate on complementarity and substitution. The new trade theory emphasizes the roles of horizontal investment and vertical investment. Horizontal investment means that source countries invest in the host country in order to produce the same product that they produce in their home countries. Makusen (1984) states that the motivation of horizontal investment is mainly based on market access and expansion. FDI in this situation is market seeking and therefore it substitutes for trade. Helpman (1984) provides another view of foreign investment. He suggests that the motivation of vertical investment is based on the difference of factor endowment. Thus, efficiency seeking FDI complements trade.

Figure 2.3 Impacts of FDI on the import of Thailand



The theory of intraindustry trade provides the view of substitution between FDI and trade. Krugman and Obstfeld (2005) indicate that the interindustry trade (cloth and food) reflects the comparative advantage while the intraindustry trade (cloth and cloth) reflects the economy of scale. If FDI seeks for economy of scale in the host country, FDI complements trade. Makusen (2000) explains the roles of multinational enterprises by showing that the vertical multinational enterprises dominate when countries are very different in relative factor endowment. On the other hand, the horizontal multinational enterprises dominate when countries are similar in size and relative endowment and trade costs are moderate to high. Figure 2.3 shows the direction of FDI and the export of Japan and the USA to Thailand. If FDI increases the export from Japan and the USA to Thailand, the export is complemented by FDI. Conversely, if FDI decreases the export of Japan and the USA to Thailand, the export is substituted by FDI.

The empirical studies on complementarity and substitution of FDI and trade are summarized here. Camarero and Tamarit (2003) studied the impacts of inbound and outbound FDI on trade of the manufacturing industries of 10 EU countries, Japan and the USA. The panel cointegration techniques were applied in their paper. The general results indicate that there is a complementary relationship between FDI and trade in OECD countries. Marjeed and Ahmad (2008) find that FDI increases the export of 49 developing countries during 1970-2004. Pain and Wakelin (1998) identified the relationship of the export performance and inward and outward investment of 11 OECD countries. They applied the standard export demand model. The results indicate that eight out of eleven countries found inward FDI complements export, while the inward FDI substitutes for export in Japan, Italy and Denmark.

In Thailand, the studies on the impacts of FDI on the export and the test of complementarity and substitution between FDI and trade are summarized as follows. Pupphavesa and Pussaransri (1994) study the relationship of FDI and export in Thailand. The Granger causality test indicates that FDI Granger-causes the export of Thailand. The relationship of FDI and the export is positive which means FDI enhances the export of Thailand. More recent work by Tambunlertchai (2009) has supported the positive impact of FDI on export performances in Thailand. She uses firm-level data to analyze factors determining the export decisions of three industries, namely textiles and clothes, foods and electronics and electrical appliances. The result indicates that foreign firms have better export performance than domestic firms. Johnson (2006), on the other hand, finds a negative impact of inflow FDI on the export of Thailand. Furthermore, the Granger Causality Test shows an independent relationship between the export and FDI.

The impacts of FDI on the manufacturing exports and the relationship between FDI and the manufacturing imports in Thailand are addressed in this paper. Due to the limitation of time series data, analysis such as the Granger causality test, vector error correction model, and panel cointegration model are not performed in this paper. This research applies the augmented gravity model since it includes important factors such as the size of market, income and distance which affect both manufacturing exports and imports. In addition, the augmented gravity model allows adding other variables into the model. The exchange rate, tariff and FDI are included in the model in order to investigate the impacts of these variables on the manufacturing trade in Thailand.

2.3 Review of the Literature on Trade Costs and Impacts of Trade Facilitation on the Manufacturing Exports of Thailand

Trade costs have become a topic of attention in the international trade context during the 2000s. Many studies have estimated trade costs and analyzed the impacts of such costs on the trade, both among countries and regions. Anderson and van Wincoop (2003) derived the gravity model from a microeconomic foundation and later called it the AvW model. The AvW model emphasizes the role of trade costs which are calculated from distance, inward and outward trade barriers. The results indicate that an absence of national border restrictions reduces trade costs between industrial countries by a moderate level of 20%-30%. Anderson and van Wincoop (2004) surveyed various measurements of trade costs and found that although trade costs were high in wealthy countries, poor countries faced even greater trade costs.

Hummels (1999) used data of freight and tariffs to estimate trade costs of the USA, New Zealand and five Latin American countries in 1994. They find freight costs play the most important role in international trade. Jack, Meissner and Novy (2008) compared trade costs of the USA, the United Kingdom and France with 18 trading partners during 1870-2000. They found that trade costs of the three countries have decreased over time. The United States had the lowest trade cost during 1870-1910 while France had the lowest trade cost from 1921 to 2000. They also investigated the factors determining trade cost. The factors determining trade costs are distance, import tariff between two countries, bilateral nominal exchange rate volatility, and dummy variables.

Chen and Novy (2009) derived the comprehensive trade costs from the AvW model. They defined them as: "Comprehensive trade costs include all additional costs involved in trading goods internationally with another partner (i.e., bilaterally) relative to those involved in trading goods intranationally (i.e., internally or domestically)" (Duval and Utoktham, 2010, p.4). The comprehensive trade costs are a general concept, which includes not only international transportation and tariff costs but also other components such as costs associated with the use of a different language and currencies. Comprehensive trade costs also include direct and indirect costs associated with completing trade procedures or obtaining necessary information (Duval and Utoktham, 2012).

Duval and Utoktham (2012) estimated the comprehensive trade costs of Asia and Pacific countries using the Chen and Novy (2009) equation. They pointed out that most countries and sub-regions had made significant progress in reducing trade costs; trade costs among Asian countries still often exceed costs of trade between Asian countries and developed countries outside the region; in fact, tariff costs account for only a small portion of comprehensive trade costs, although tariff cuts accounted for a large share of overall trade cost reduction during the past decade. Arvis et al. (2012) re-estimated trade costs during 1995-2010 of the manufacturing and agriculture industries using a new data set of 178 countries. The results clearly indicated that trade costs were falling noticeably faster in developed countries than in developing countries. They also found that maritime transport connectivity and logistics performance were important factors in determining trade costs between two countries.

Because many countries have improved trade facilitation such as infrastructure and trade procedures, it is important to investigate the impacts of trade facilitation on trade. De (2006) applied the augmented gravity model to eight sectors in 10 Asian countries in order to examine the effects of both policy and non-policy barriers on trade. Infrastructure quality, transportation and tariffs were found to be the main determinants for Asia's trade flows. Shepherd and Wilson (2008) estimated trade costs resulting from various factors, such as distance, tariff rates, and quality of airports and seaports, in order to study the impact of trade costs on trade by ASEAN member countries. They used that information to produce a gravity model of exports and imports in the region. The results indicated that a 1% increase in bilateral distance decreased trade by 0.4%, applied tariffs increased intra-regional trade by about 2%, and improved port facilities boosted trade by 7.5%.

Moise and Sorescu (2013) studied the impacts of trade facilitation on trade by developing countries. Sixteen trade facilitation factors were constructed from Organization for Economic Co-operation and Development (OECD) database and other sources. They also used ESCAP and ESCAP-World Bank trade costs database. The result suggests that enhancing trade facilitation had positive impacts on trade flow. Furthermore, it was apparent that the most significant trade facilitation measures (i.e. those that have the highest impact on trade volumes) were information availability, harmonization and simplification of documents, automated processes and risk management, streamlining of border procedures, and good governance and impartiality.

Based on previous literature, there are some gaps in the research that need to be filled regarding trade costs. Many studies have applied different techniques and factors to estimate trade costs, which have yielded various results. The comprehensive trade costs model of Chen and Novy (2009) is applied in this paper because data to estimate the manufacturing trade costs of Thailand are available. The study follows the approach of

Duval and Utoktham (2012) in estimating the manufacturing trade costs by using different data sets. Furthermore, the comprehensive trade costs are decomposed into their components; therefore, the contribution of their components to trade costs can be analyzed. The impacts of trade facilitation-including time spent and documents in the processing of exports and imports on the manufacturing exports by Thailand are also discussed in this paper. This research applies the augmented gravity model in the investigation of the impact of trade facilitation on the manufacturing exports of Thailand.

CHAPTER III: METHODOLOGY AND DATA

The methodology and data used in Chapter IV, V and VI are discussed in this chapter. Section 3.1 explains the trade performance indicators, six RCA indices, and the approach used to investigate patterns of comparative advantage that will be used in Chapter IV. Section 3.2 presents the augmented gravity model as applied to the investigation of the impacts of FDI on the manufacturing trade of Thailand for analysis in Chapter V. Section 3.3 shows the method to derive and calculate the comprehensive trade costs model of Chen and Novy (2009). In addition, the augmented gravity model examines the impact of trade facilitation on the manufacturing exports of Thailand for the analysis in Chapter VI.

3.1 Trade Performance, Capital and Labor Intensity and Patterns of Comparative Advantage of Manufacturing Trade in Thailand

3.1.1 Trade Performance

This section includes indicators which reveal changes in the commodity structure of trade. They also are relevant for formulation of development strategies, as they reflect directly or indirectly the competitive ability of a country or region's economic sectors or activities. The indices covered in this section are the export and import share, market power index, growth rate of exports and imports, and RCA indices.

A) Export and Import Share

Export share measures extent of diversification of exports across sectoral categories. It is defined as the value of sectoral export divided by total exports of a given economy which is expressed by

$$EXS_{i,t} = \frac{EX_{i,t}}{\sum_{i=1}^{n} EX_{i,t}} \times 100 \tag{3.1}$$

where $EXS_{i,t}$ is the export share of industry i at time t and $EX_{i,t}$ is the export of industry i at time t. The value of EXS ranges from 0 to 100%. The higher the percentage of EXS, the greater the importance of the product i in the export profile of the country. The import shares are calculated in the same manner as calculating the export share.

B) Market Power Index

Market power index measures an indirect international market power, evaluated through a country's share of world markets in selected export categories. It is defined as the share of total exports of a given product from the country under study out of total world exports of the same product which is expressed by

$$MPI_{i,t}=\frac{EX_{i,t}}{EX_{i,t}^{w}} \times 100 \tag{3.2}$$

where $MPI_{i,t}$ is market power index of industry i at time t. $EX_{i,t}^{w}$ is total export of industry i at time t in the world market, $EX_{i,t}$ is the export of industry i at time t. MPI takes values between 0 to 100%, with a higher value indicating a greater market power of the industry.

C) Growth Rate of Export and Import

Growth rate of an export measures the movement of industry. It is defined as an annual compound percentage change in the value of the export of one industry between two periods, which is expressed by

$$GEX_{i,t} = \frac{EX_{i,t} - EX_{i,t-1}}{EX_{i,t-1}} \times 100 \tag{3.3}$$

where $GEX_{i,t}$ is growth rate of export of industry i at time t. $EX_{i,t}$ is the export of industry i at time t, $GEX_{i,t}$ is the growth rate of export of industry i at time t. GEX takes value from -100 (if trade ceases) to $+\infty$. The value zero means trade does not change. The growth rate of import is calculated in the same method as calculating the growth rate of export.

3.1.2 Revealed Comparative Advantage (RCA) and Alternative Indices

This section gives details on the method to calculate and explain the meaning of the six RCA indices. The RCA indices include the original RCA, multiplicative RCA, addictive RCA and trade accumulation RCA. The comparison methods for the six indices are presented by using statistical properties and empirical evidence. One RCA index will be selected as a benchmark for analyzing the trade performance of the manufacturing industry in Thailand.

A) Balassa RCA (BRCA)

Ballasa (1963) first developed the RCA index. BRCA measures which sectors in an economy have a comparative advantage, by comparing the country of interest's trade profile with the world average. It is defined as a ratio of two shares. The numerator is the share of a country's total exports of the commodity of interest from its total exports. The denominator is share of world exports of the same commodity out of total world exports.

$$BRCA_i = \frac{EX_i^d / \sum_{i=1}^{n} EX_i^d}{EX_i^w / \sum_{i=1}^{n} EX_i^w} \tag{3.4}$$

where EX_i^d is the export of industry *i* from country d, EX_i^w is the export of industry i from the world *w*, $\sum_{i=1}^{n} EX_i^d$ is total export of country *d*, $\sum_{i=1}^{n} EX_i^w$ is total export of the world. $BRCA_i$ takes a value from 0 to $+\infty$. The industry *i* has a revealed comparative advantage if $BRCA_i > 1$, has a revealed comparative disadvantage if $0 < BRCA_i < 1$ and has comparative advantage at neutral point if $BRCA_i = 1$. The demarcation of $BRCA$ index is not symmetric. Thus, using $BRCA$ for comparison across countries, industries, and time is not suitable.

B) Symmetric RCA (SRCA)

Vollrath (1991) attempted to solve the asymmetric problem in BRCA by suggesting the log transformation of BRCA. However, Vollrath's RCA incurs a problem in the case of a zero value of BRCA. Therefore, Dalum et al. (1998) developed another symmetric RCA index without the zero issue. The symmetric RCA is defined as follows:

$$SRCA_i = \frac{BRCA_i - 1}{BRCA_i + 1} \tag{3.5}$$

The value of $SRCA_i$ ranges from -1 to 1 and equals zero at the comparative advantage at the neutral point. The industry *i* has comparative advantage if $0 < SRCA_i \leq 1$, has comparative disadvantage if $0 > SRCA_i \geq -1$ and has comparative advantage at the neutral point if $SRCA_i = 0$. However, the mean of $SRCA_i$ is not stable over space and time.

C) Weighted RCA (WRCA)

Proudman and Redding (2000) fix the mean of BRCA by normalizing BRCA with its cross-section mean where the index is defined as below.

$$WRCA_i = \frac{BRCA_i}{1/n \sum_{i=1}^{n} BRCA_i} \tag{3.6}$$

where *n* is number of industries. The value of $WRCA_i$ ranges from 0 to +∞. Industry *i* has comparative advantage if $WRCA_i > 1$, has comparative disadvantage if $0 < WRCA_i < 1$ and has comparative advantage at the neutral point if $WRCA_i = 1$. The $WRCA_i$ also has the asymmetric problem.

D) Additive RCA (ARCA)

Hoen and Oosterhaven (2006) introduced an additive form of BRCA to overcome the weaknesses of the multiplicative forms of RCA (BRCA, SRCA, and WRCA). The ARCA is defined as follows:

$$ARCA_i = \frac{EX_i^d}{\sum_{i=1}^{n} EX_i^d} - \frac{EX_i^w}{\sum_{i=1}^{n} EX_i^w} \tag{3.7a}$$

Under the situation of BRCA at neutral point, country *d's* export industry i, $\widehat{EX}_i^d$, equals $\sum_{i=1}^{n} EX_i^d \times EX_i^w / \sum_{i=1}^{n} EX_i^w$. ARCA can be defined as the level deviation of country *d*'s exports in industry *i* from its comparative advantage at neutral point as the following.

$$ARCA_i = \frac{EX_i^d - \widehat{EX}_i^d}{\sum_{i=1}^{n} EX_i^d} \quad (3.7b)$$

The values of ARCA fall in between -1 and +1 and equal to 0 at comparative advantage at the neutral point. The industry *i* has comparative advantage if $0 < ARCA_i < 1$ and has comparative disadvantage if $0 > ARCA_i > -1$. Although the ARCA has zero mean and symmetric property, the denominator, $\sum_{i=1}^{n} EX_i^d$, changes from country to country. Therefore, it is biased to compare ARCA across countries (Bebek, 2011).

E) Normalized RCA (NRCA)

Yu, Cai, and Leung (2008) derived the Normalized Revealed Comparative Advantage (NRCA) index which measures the degree of deviation of a country's actual export from its comparative advantage neutral level in term of its relative scale with respect to the world export market. Country d's actual export in industry *i* in the real world, EX_i^d, would normally differ from $\widehat{EX}_i^d$ and the difference can be stated as

$$\Delta EX_i^d = EX_i^d - \widehat{EX}_i^d = EX_i^d - \frac{\sum_{i=1}^{n} EX_i^d \times EX_i^w}{\sum_{i=1}^{n} EX_i^w} \quad (3.8)$$

Normalizing (3.8) by the world export, $\sum_{i=1}^{n} EX_i^w$, then NRCA is expressed as

$$NRCA_i = \frac{EX_i^d}{\sum_{i=1}^{n} EX_i^w} - \frac{\sum_{i=1}^{n} EX_i^d \times EX_i^w}{\sum_{i=1}^{n} EX_i^w \times \sum_{i=1}^{n} EX_i^w} \quad (3.9a)$$

$$NRCA_i = \frac{EX_i^d - \widehat{EX}_i^d}{\sum_{i=1}^{n} EX_i^w} \quad (3.9b)$$

$NRCA_i > 0$ ($NRCA_i < 0$) indicates that a county actually exports commodity *i* at a higher (lower) level than its comparative advantage neutral level ($BRCA = 1$), signifying that the country has comparative advantage (disadvantage) in commodity *i*. The denominator of equation (3.9b), $\sum_{i=1}^{n} EX_i^w$, is different from industry to industry. Thus, it is biased to compare NRCA across industries (Bebek, 2011).

F) Michelaye Index

Another shortcoming of multiplicative and additive RCA indices is that it concentrates only on the export side. The import has to be taken into account in order to analyze comparative advantage of the country if the country has large value of intra industry trade or imports intermediate goods to produce the final product. The country creates a small portion of value added if the country imports a large value of intermediate goods. In such a situation, the RCA indices do not reflect the real situation of comparative advantage of the country. The Michelaye index is an alternative index for RCA which includes export and import. The index is defined as follows:

$$MI_i = \frac{EX_i^d}{\sum_{i=1}^{n} EX_i^d} - \frac{IM_i^d}{\sum_{i=1}^{n} IM_i^d} \tag{3.10}$$

where EX_i^d is the export of industry i from country d. IM_i^d is the import of industry i of country d. The value of MI_i ranges from -1 to 1. The country is said to have a comparative advantage in industry i when the value exceeds zero and a comparative disadvantage in industry i when the value falls below zero. MI here is calculated in order to support the result of export-only RCA.

G) Comparison of RCA Indices

In order to select one index as a benchmark for comparison of the RCA across industries and over time, the indices should satisfy the statistical properties such as stability of mean and symmetry. By stability of mean, it implies that the mean across industries should not change if RCA indices are compared over time. Hoen and Oosterhaven (2006) suggest that for a robust comparison of RCA indices, the expected value of the comparative average sector should be identical across space and time. Symmetry means the demarcation of RCA indices on the left and on the right should have equal boundaries. Sanidas and Shin (2010) and Bebek (2012) summarized the statistical properties of five indices as shown in the Table 3.1.

Table 3.1 Statistical properties of five RCA indices

Export-only RCA	BRCA	SRCA	WRCA	ARCA	NRCA
Comparative at neutral point	1	0	1	0	0
Range	$(0, +\infty)$	$(-1, +1)$	$(0, +\infty)$	$(-1, +1)$	$(-1, +1)$
Mean across industries	Unstable	Unstable	Unstable	Unstable	Stable
Symmetry	No	Yes	No	Yes	Yes

Source: Sanidas and Shin (2010) and Bebek (2011)

NRCA seems to be the ideal RCA index because it satisfies two statistical properties. However, NRCA suffers from an inconsistency in the denominator (see equation 3.9b) when comparing these indices across industries and times. Sanidas and Shin (2010) and Bebek (2012) propose an alternative approach to compare the RCA indices by using empirical evidence. They suggest calculating and ranking all RCA indices. Then, they compare RCA indices by using a correlation of RCA indices and corresponding ranking across industries and over time. If the correlation between RCA indices and their ranks is equal to one, a perfect correlation, it implies a monotonic increase in the value of RCA when the rank increases by one order. In this situation, industry A and industry B can be compared and it can be shown by how much industry A is stronger in comparative advantage than industry B. However, there is rarely perfect correlation between RCA indices and their ranks in the empirical studies. Therefore, the highest correlation between five RCA indices across industries and time is selected as a benchmark for comparative advantage analysis in this paper. Five RCA indices are calculated and ranked for the manufacturing industry of Thailand at product group level (3-digit level).

This section covers the manufacturing industry in Thailand at the product group level and at the aggregate level. The manufacturing industry in Thailand is classified based on International Standard Industry Classification (ISIC). The ISIC classifies the industry into Section, Division, Group and Class. Section is divided into 17 sections, and manufacturing is in Section D. Section D includes 23 divisions and 61 groups of industry. The export data covers 57 groups of industries from manufacturing of processing and preservation of meat, fish, fruit, vegetables, oils and fats (151) to manufacturing of not classified elsewhere in other groups (369) (see Table A.1 in Appendix A).

3.1.3 Capital and Labor Intensity and Patterns of Comparative Advantage

This section emphasizes the role of capital and labor intensity and the patterns of comparative advantage. Two approaches are used in this section. Firstly, one RCA index is selected from section 3.1.2. The manufacturing industries are classified into four groups based on capital labor ratio and then their trends of comparative advantage are analyzed. The trend of comparative advantage is simply estimated by using the equation below:

$$RCA_t = \beta_0 + \beta_1 t \qquad (3.11)$$

where β_0 is intercept, β_1 is coefficient of time trend ($\beta_1 > 0$ indicates RCA increase, $\beta_1 < 0$ indicates RCA decrease), and t is time.

Second, the analysis of the factors determining the comparative advantage of the manufacturing industry at industry group level (3-digit level) is applied. Branson and Monoyios (1977) predicted the direction of trade regarding the factor intensity of industry. They adjusted a two-factor model to a multi-factor model. In the multi-factor model, capital, skilled labor and unskilled labor are the main factors to explain the direction of trade and comparative advantage. Stern and Maskus (1981) also use a multi-factor model to explain the structure of the United States foreign trade during 1958-76. Derived from both studies, the model is defined by

$$NX_i = f(K_i, USKL_i, SKL_i) \qquad (3.12)$$

where the linear function is

$$NX_i = \alpha_0 + \alpha_1 K_i + \alpha_2 USKL_i + \alpha_3 SKL_i + u_i \qquad (3.13)$$

NX_i is net export, export minus import, of industry i. K_i is total net fixed asset as a proxy of capital of industry i. $USKL_i$ and SKL_i are unskilled labor and skilled labor of industry i respectively. $USKL_i$ is unskilled labor where it is the numbers of operative labor of industry i. Operative labor refers to persons who are directly engaged in the production process or other related activities and receive regular pay in terms of wages or salaries. SKL_i is skilled labor of industry i where it is defined as labor other than operative labor, they are administrative, technical, and clerical workers such as salaried managers and directors, laboratory and research workers, clerks, typists, bookkeepers and administrative supervisors, salesmen and the like.

The sign of the coefficient of independent variables shows a direction of trade. For example, if the coefficient $\alpha_1$in the equation (3.13) is positive, then the manufacturing industry exports the capital-intensive goods; in other words, they have comparative advantage. On the other hand, if the coefficient α_1 is negative, then the manufacturing industry imports the capital-intensive goods; in other words, they have the comparative disadvantage. The explanation of the sign of α_2 and α_3 is the same as for the sign of α_1. The data in model (3.13) is cross-sectional and characteristics of the manufacturing industry vary among sub-industries. Therefore, it is suspected that heteroskedasticity may be present in the result of regression. The Breucsh-Pagan test for heteroskedasticity is applied in this study, and it is remediated by using the robust standard error.

Harkness and Kyle (1975) and Stern and Maskus (1981) argue about model (3.13) that it cannot be used as a basis for analyzing the determinant of a country's net export. There is no theory saying that the industry with high capital or labor will have a higher net export surplus. Furthermore, the export also depends on the demand side, and model (3.13) has ignored that. The multi factor proportion model can predict only the direction but not the volume of trade. Therefore, the net export (NX) considers only the industry as a net exporter or net importer regardless of the absolute or relative dimensions. The net export (NX_i) in the previous model (3.13) becomes one if industry i is a net exporter, and zero if industry i is a net importer. Therefore, the logit model is used to estimate the direction of trade. In both studies, the factors determining the comparative advantage are set in a linear function as

$$Y_i = \alpha + \beta X_i + \varepsilon_i \tag{3.14}$$

where Y_i is a binary dependent variable ($Y_i = 1$ if NX_i is positive and $Y_i = 0$ if NX_i is negative) and X_i is a characteristic of industry i. β is a vector of parameters and ε_i is the error term. Model (3.14) is estimated by using the linear probability model (LPM) as follows

$$P_i = E(Y_i = 1/X_i) = \alpha + \beta X_i \tag{3.15}$$

where P_i is probability that $Y_i = 1$ and $(1-P_i)$ is probability that $Y_i = 0$. However, the LPM has several problems such as non-normality of u_i, hesteroskedasticity of u_i, and generally lower R^2 (Gujarayi, 2003). Therefore, the logit model replaces model (3.13) and is expressed as

$$P_i = E(Y_i = 1/X_i) = \frac{1}{1 + e^{-(\alpha + \beta X_i)}} \tag{3.16}$$

$$P_i/(1 - P_i) = e^{(\alpha + \beta X_i)} \tag{3.17}$$

$$\ln(P_i/(1 - P_i)) = \alpha + \beta X_i \tag{3.18}$$

The logit model essentially means that the logarithm of the odds of an industry being a net exporter is linear in independent variables. The characteristics of industry, X_i, in this model are the capital-labor ratios (*KL*), and share of skilled labor to total labor (*SE*). The total net fixed asset of industry i is a proxy of the capital. In this section, the skilled labor is defined as in the previous section. Therefore, the share of skilled labor (*SE*) is the ratio of skilled labors to total labor. The sign of the coefficient of independent variables shows the direction of trade regarding factor intensity of industry. A positive sign of the coefficient of the capital-labor ratio is interpreted as the manufacturing industry having capital-intensity in exporting goods; conversely, the negative sign of the coefficient shows that the manufacturing industry has been labor-intensive in exporting goods. A positive sign of a coefficient of skilled labor to the total labor ratio means the manufacturing industry has exported skilled labor-intensive goods and vice versa in the case of a negative sign of a coefficient.

In the manufacturing census in 2007, the operative labor can be classified into two groups, skilled operative and unskilled operative labor. Skilled operative labor refers to workers in a production line who have been trained at least three months or have work experience of at least five years in specific work. Therefore, the skilled operative labor is defined as medium skilled labor in this study. They are machine controllers, assemblers, and workers who specialize in machine maintenance and set up machine equipment. The unskilled operative labor refers to workers in the production line who have been trained at least two weeks. They are machine tenders, workers in a factory, and caretakers. In order to check the direction of trade of manufacturing industry in Thailand whether it exports low skilled labor-intensive goods, the variable MSE is formed. MSE is the ratio of operative skilled labor plus skilled labor divided by total labor.

Table 3.2 Summary of data sources for model 3.13

Variables	Data source
Export and import of the manufacturing industry	World Integrated Trade Solution, Retrieved on May 12, 2012 at https://wits.worldbank.org/WITS/WITS/Restricted/Login. aspx
Capital and labor	National Statistics Office (NSO) of Thailand

The main source of the data on the characteristics of the manufacturing industry is from the National Statistics Office (NSO) of Thailand. The data on manufacturing at the industry groups and firm level are taken from manufacturing industry censuses in the years 1997 and 2007. The manufacturing industry censuses cover 54 and 56 groups of industry in the year 1997 and 2007 respectively. The manufacturing industry census has been conducted every ten years; however, the NSO has rescheduled the census to be conducted every five years. The new census is expected to be carried out in the year 2012. The manufacturing industry census covers the operation of firms from 1st January to 31st December of the preceding year. For example, the industry census in 2007 covered the operation of firms from 1st January to 31st December 2006. The data of this section are obtained from the source in the Table 3.2.

3.2 Impacts of FDI on Manufacturing Trade of Thailand

This section applies the augmented gravity model to analyze the impacts of FDI on manufacturing trade of Thailand. Tinbergen (1962) introduced the gravity model to the international trade flow. Since then, thousands of published articles and working papers have followed his theory. The general form of the gravity model is expressed as follows:

$$F_{ij} = G\frac{M_i M_j}{D_{ij}} \tag{3.19}$$

where F_{ij} is trade flow from country i to country j, M_i and M_j are the economic size of the relevant countries which are usually measured by their GDPs, G is a gravitational constant, and D_{ij} is distance from country i to country j.

Recent studies (Ross and Wincoop, 2001; De, 2006; Xuan and Xing, 2006; Chaisrisawatsuk and Chaisrisawatsuk, 2007) expand the gravity model by including factors such as macroeconomic factors, institution and investment policy in order to analyze the impact of these factors on the trade flow. FDI is added into the gravity model to observe the impacts of FDI on the manufacturing exports in Thailand. From figure 2.1 and the augmented gravity model, the impacts of FDI on the manufacturing exports from Thailand to source countries are formed in the following equation:

$$EX_{ij,t} = f\left(GDP_{i,t}, GDP_{j,t}, DIS_{ij}, T_{ji,t}, EXCH_{ij,t}, FDI_{ji,t}, D_{gfc}\right) \tag{3.20}$$

where the subscripts i and j refer to Thailand and source country j, respectively. The variables in equations (3.20) are defined as follows. $EX_{ij,t}$ is the value of manufacturing exports from Thailand to country *j* at time *t* deflated by export price. $GDP_{i,t}$ and $GDP_{j,t}$ are GDP at constant price (base year = 2005) of Thailand and country *j*, respectively. DIS_{ij} is the distance from Thailand to country *j*[2]. $T_{ji,t}$ is import tariff of the manufacturing industry that country *j* imposes on Thailand at time *t*. $EXCH_{ij}$ is the real bilateral exchange rate between country *j* and Thailand at time *t*. It is defined as

$$EXCH^j = \frac{FC^j}{HC} \times \frac{P}{P^j} \tag{3.21}$$

where FC^j is foreign currency; HC is home country currency (Thai Baht); P is home country's consumer price index, P^j is foreign country's consumer price index. $FDI_{ji,t}$ is foreign direct investment in the manufacturing industry from country *j* to Thailand. It is defined as the real value of FDI which has already been invested. If the value of FDI is zero, the natural logarithm of FDI is not defined. The solution from Ismail, Smith, and Kugler (2009) is to add one to all values of FDI and then take a natural logarithm. D_{gfc} is the dummy variable for the global financial crisis in 2007 where it is 1 from 2007 to 2010 and 0 otherwise.

According to figure 2.2, the impact of FDI on the export of the manufacturing industry from Thailand to other countries can be formed as the following equation:

$$EX_{ioj,t} = f\left(GDP_{it}, GDP_{oj,t}, DIS_{ioj}, T_{oj,t}, REER_t, FDI_{ji,t}, D_{gfc}\right) \tag{3.22}$$

where $EX_{ioj,t}$ is the weighted average of real manufacturing exports from country *i* to other countries except country *j* at time *t*. $GDP_{i,t}$ is GDP at constant price (base year = 2005) of Thailand at time *t*, $GDP_{oj,t}$ is the weighted average of GDP at constant price (base year = 2005) of other countries except country *j* at time *t*. DIS_{ioj} is the weighted average distance

---

[2] See details of calculation in Head and Mayer (2002) and Mayer and Zignago (2011)

from country i to other countries except country j. $T_{oj,t}$ is the weighted average import tariff of other countries except country j at time t. $REER_t$ is the real effective exchange rate at time t. REER is calculated by using 22 countries' currencies and weighting them by the volume of trade. The weight is calculated by dividing the trade of Thailand with country j by the total trade of Thailand.

$$REER = \sum_{i=1}^{n} w^j \times \frac{FC^j}{HC} \times \frac{P}{P^j} \tag{3.23}$$

where $\sum_{i=1}^{n} w^j = 1$ and

$$w^j = \frac{EX^j + IM^j}{\sum_{j=1}^{n} EX^j + \sum_{i=1}^{n} IM^j} \tag{3.24}$$

where FC^j is foreign currency; HC is home country currency (Thai Baht); P is home country's consumer price index; P^j is foreign country's consumer price index; EX^j and IM^j are export and import of Thailand with trading partner country j.

Regarding Figure 2.3, the test of complementarity and substitution between FDI and the manufacturing exports can be observed through the gravity model as in the functions as follow:

$$EX_{ji,t} = f\left(GDP_{i,t}, GDP_{j,t}, DIS_{ij}, T_{ij,t}, EXCH_{ij,t}, FDI_{ji,t}, D_{gfc}\right) \tag{3.25}$$

$EX_{ji,t}$ is the manufacturing exports from country j to Thailand at time t (or it is the manufacturing imports of Thailand from country j) deflated by import price of the manufacturing industry. $T_{ij,t}$ is import tariff of the manufacturing industry that Thailand imposes on country j and the rest are defined as in equation (3.20).

Table 3.3 Summary of data sources for models (3.20), (3.22) and (3.25)

Variables	Data source
Export of the manufacturing industry and tariff rate	World Integrated Trade Solution, Retrieved on May 12, 2012 at https://wits.worldbank.org/WITS/WITS/Restricted/Login. aspx

GDP of source and host country	World DataBank, Retrieved on May 12, 2013 http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Distance	CEPII, Retrieved on May 12, 2012 http://www.cepii.fr/anglaisgraph/bdd/gravity.asp
Exchange rate and CPI	International Financial Statistic in 2011 (CD ROM)
FDI in the manufacturing industry	Board of Investment, Thailand

The impacts of FDI on the export of the manufacturing industry using the augmented gravity model employed a panel data set of 22 source countries over the period 1999 to 2010. The manufacturing exports cover more than 90% of total export and include product groups from 15 to 37 under ISIC classification. In addition, FDI from these countries share around 92% of total investment in the manufacturing industry in Thailand.

3.3 Trade Costs and Impacts of Trade Facilitation on the Manufacturing Export of Thailand

3.3.1 Comprehensive Trade Costs

This section firstly estimates trade costs of the manufacturing industry between Thailand and its trading partners. Since the comprehensive trade costs model of Chen and Novy (2009) is derived from AvW model, a brief introduction of the AvW model is presented here. The theoretical structure of AvW[3] model resembles the gravity model. Shepherd (2012) explained the process of deriving the AvW model in four steps. Firstly, the model's consumption side from "Love of Variety" is set. Secondly, the model's supply side from the assumption of a large number of symmetric firms in each country that engage in monopolistic competition is addressed. Thirdly, trade cost and related domestic and foreign prices are introduced. Finally, all equations are aggregated with macro identities in order to produce the gravity-like model. The AvW model is specified as:

[3] Please see details of the derivation of the AvW model in Appendix C, Section C.3

$$X_{ij}^{k} = \frac{Y_i^k E_j^k}{Y^k} \left\{ \frac{\tau_{ij}^k}{\Pi_i^k P_j^k} \right\}^{1-\sigma_k} \quad (3.26)$$

where $X_{ij,t}^{k}$ is total export of sector *k* from country *i* to country *j*; Y_i^k is income of country *i* earned from total worldwide sales of all locally-made varieties in sector *k;* E_j^k is country *j'*s expenditure in sector *k;* Y^k is total world output in sector *k*; σ_k is intra-sectoral elasticity of substitution of sector *k*; and τ_{ij}^k is trade costs of sector *k* from country *i* to country *j*. Trade of an "ice-berg" can be used as an example of τ_{ij}^k. The exporter must export more than one unit of ice in order to have one unit of ice at the destination, since the ice melts during the transportation. Trade cost measures how much of the ice is melting.

The outward multinational resistance, Π_i^k, essentially captures the fact that exports from country *i* to country *j* depend on trade costs across all possible export markets and is defined as follows:

$$\Pi_i^k = \sum_{j=1}^{c} \left\{ \frac{\tau_{ij}^k}{P_j^k} \right\}^{1-\sigma_k} \frac{E_j^k}{Y^k} \quad (3.27)$$

In other words, the export from country *i* to country *j* depends not only on bilateral trade costs but also on trade costs affecting country *i*'s export to other markets.

The inward multinational resistance, P_j^k, captures the dependence of imports into country *i* from country *j* on trade costs across all possible suppliers and is specified as:

$$P_j^k = \sum_{i=1}^{c} \left\{ \frac{\tau_{ij}^k}{\Pi_j^k} \right\}^{1-\sigma_k} \frac{Y_i^k}{Y^k} \quad (3.28)$$

In other words, the import of country *i* from country *j* depends not only on bilateral trade costs but also on trade costs affecting country *j*'s imports from other markets.

The comprehensive trade costs model of Chen and Novy (2009) is derived as follows. Recall the AvW model as shown below:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left(\frac{\tau_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (3.29)$$

where X_{ij} denotes the nominal exports from i to j; Y_i and Y_j denotes the nominal income from country i and j, respectively; Y denotes world income; $\sigma > 1$ denotes elasticity of substitution across goods; Π_i denotes outward multinational resistance of country i; P_j denotes inward multinational resistance from country j; and τ_{ij} denotes bilateral trade costs (as one plus ad valorem term). Chen and Novy (2009) suggested the expression of intra-national trade should be made as:

$$X_{ii} = \frac{Y_i Y_i}{Y}\left(\frac{\tau_{ii}}{\Pi_i P_i}\right)^{1-\sigma} \tag{3.30}$$

where τ_{ii} becomes intranational trade costs. Re-arranging equation (3.30) as the product of multilateral resistance terms yields:

$$X_{ii} = \frac{Y_i Y_i}{Y}\left(\frac{\Pi_i P_i}{\tau_{ii}}\right)^{\sigma-1}$$

$$(\Pi_i P_i)^{\sigma-1} = \frac{X_{ii} Y}{Y_i Y_i}\tau_{ii}^{\sigma-1}$$

$$(\Pi_i P_\mathrm{i})^{\sigma-1} = \frac{X_{ii}/Y_i}{Y_i/Y}\tau_{ii}^{\sigma-1}$$

$$\Pi_i P_\mathrm{i} = \left(\frac{X_{ii}/Y_i}{Y_i/Y}\right)^{\frac{1}{\sigma-1}}\tau_{ii} \tag{3.31}$$

Using the same concept, the opposite direction of trade flows in equation (3.29) can be written as

$$X_{ji} = \frac{Y_j Y_i}{Y}\left(\frac{\tau_{ji}}{\Pi_j P_i}\right)^{1-\sigma} \tag{3.32}$$

Multiplying equations (3.29) and (3.32) together gives:

$$X_{ij}X_{ji} = \left(\frac{Y_i Y_j}{Y}\right)^2\left(\frac{\tau_{ij}\tau_{ji}}{\Pi_i \Pi_j P_i P_j}\right)^{1-\sigma}$$

Substitute with the result from equation (3.31):

$$X_{ij}X_{ji} = \left(\frac{Y_iY_j}{Y}\right)^2 \left(\frac{\Pi_i\Pi_jP_iP_j}{\tau_{ij}\tau_{ji}}\right)^{\sigma-1}$$

$$X_{ij}X_{ji} = \left(\frac{Y_iY_j}{Y}\right)^2 \left(\frac{1}{\tau_{ij}\tau_{ji}}\right)^{\sigma-1} \left(\frac{X_{ii}/Y_i}{Y_i/Y}\right)\tau_{ii}^{\sigma-1}\left(\frac{X_{jj}/Y_j}{Y_j/Y}\right)\tau_{jj}^{\sigma-1}$$

$$X_{ij}X_{ji} = \left(\frac{\tau_{ii}\tau_{jj}}{\tau_{ij}\tau_{ji}}\right)^{\sigma-1} X_{ii}X_{jj}$$

$$\frac{X_{ij}X_{ji}}{X_{ii}X_{jj}} = \left(\frac{\tau_{ii}\tau_{jj}}{\tau_{ij}\tau_{ji}}\right)^{\sigma-1}$$

Then, the product of bi-directional trade costs relative to the product of their intra-national trade cost is equivalent to:

$$\frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{\sigma-1}} \tag{3.33}$$

Therefore, the geometric average of bilateral trade cost is defined as:

$$t_{ij} = \left(\frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}}\right)^{1/2} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} \tag{3.34}$$

The tariff-equivalent term is made by deducting one from equation (3.34), thus giving:

$$t_{ij} = \left(\frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}}\right)^{1/2} - 1 = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{3.35}$$

Trade costs of sector *k* at time *t* is defined as:

$$t_{ij,t}^k \equiv \left(\frac{\tau_{ij,t}^k\tau_{ji,t}^k}{\tau_{ii,t}^k\tau_{jj,t}^k}\right)^{\frac{1}{2}} = \left(\frac{X_{ii,t}^kX_{jj,t}^k}{X_{ij,t}^kX_{ji,t}^k}\right)^{\frac{1}{2(\sigma_k-1)}} \tag{3.36}$$

where $t_{ij,t}^k$ = comprehensive trade cost, which is calculated by geometric average trade costs of sector *k* between country *i* and country *j* at time *t*;

$\tau_{ij,t}^k$= international trade costs of sector *k* from country *i* to country *j* at time *t*;

$\tau_{ji,t}^k$= international trade costs of sector *k* from country *j* to country *i* at time *t*;

$\tau_{ii,t}^k$= intra-national trade costs of sector *k* in country *i* at time *t*;

$\tau_{jj,t}^k$= intra-national trade costs of sector *k* in country *j* at time *t;*

$X_{ij,t}^{k}$= international trade flows of sector *k* from country *i* to country *j* at time *t*;

$X_{ji,t}^{k}$= international trade flows of sector *k* from country *j* to country *i* at time *t*;

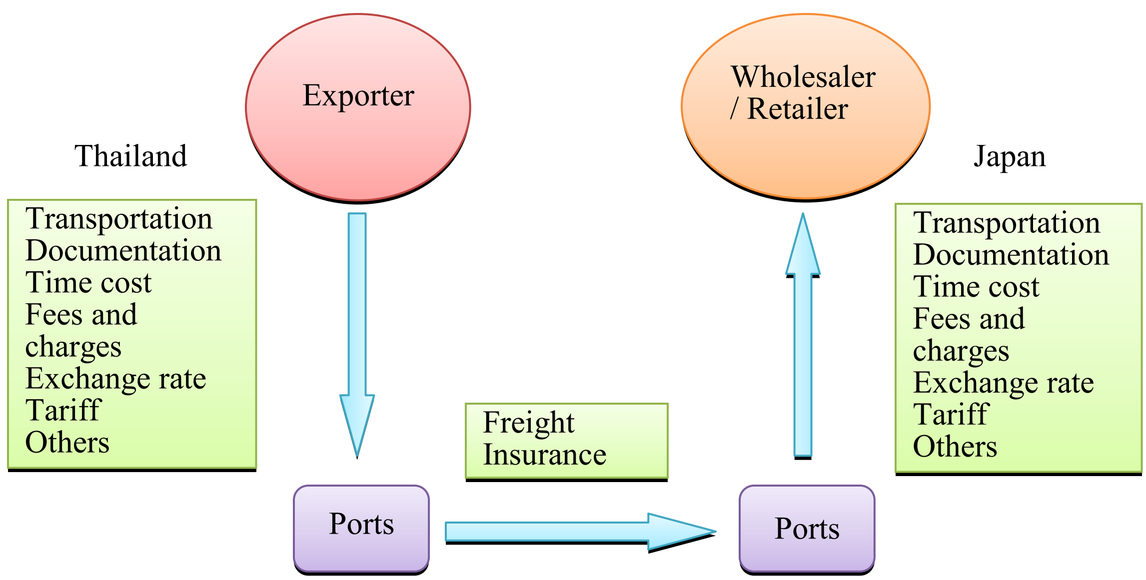
$X_{ii,t}^{k}$= intra-national trade of sector *k* in country *i* at time *t;*

$X_{jj,t}^{k}$= intra-national trade of sector *k* in country *j* at time *t;*

σ_k= sector specific elasticity of substitution between goods in sector *k.*

Sector *k* can be agriculture, industry, fishery and service. However, this study focuses on the manufacturing industry. Therefore, *k* is the manufacturing industry. According to equation (3.36), trade costs are directly inferred from observable bilateral and intra-national (domestic) trade data, showing how much more expensive bilateral international trade is relative to intra-national trade. In order to understand the concept of comprehensive trade costs, an example of the flow of exports from Thailand to Japan is provided in Figure 3.1.

Figure 3.1. Trade costs in export flows from Thailand to Japan



From the factory to port in Thailand, the exporter is required to obtain export documents, which generates costs such as fees and charges, transportation and export tariffs (if any). Then the shipment of cargo from the port in Thailand to the port in Japan incurs freight and insurance costs. Trade costs from the port in Japan to sellers include the costs of obtaining essential documents, import tariffs, transportation, fees, charges and etcetera. Trade costs also include all currency exchange costs. Therefore, comprehensive trade costs include all costs that are formulated during the shipment from the exporter in Thailand to wholesaler/retailer in Japan. It should be noted here that comprehensive trade costs are the average of trade costs from country *i* to country *j* and trade costs from country *j* to country *i*. From the example, the comprehensive trade costs for Thailand and Japan are the average total trade costs from Thailand to Japan and from Japan to Thailand.

In order to calculate comprehensive trade costs, data are required on the manufacturing exports from country *i* to country *j* and the manufacturing exports from country *j* to country *i*. The exports by the manufacturing industry cover the industry from product group 15 to 37 under ISIC classification. The sources of data used in this section are given in Table 3.4.

Table 3.4 Summary of data sources of trade costs

Variables	Data source
Manufacturing exports	World Integrated Trade Solution. Retrieved on January 13, 2013, at https://wits.worldbank.org/WITS/WITS/Restricted /Login.aspx
Gross outputs of the manufacturing industry	UN National Account database. Retrieved on January 10, 2013, at http://unstats.un.org/unsd/snaama/selbasicFast.asp
Value added of the manufacturing industry	UNCTADSTAT database. Retrieved on February 7, 2013, at http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx
Manufacturing exports by Singapore	*Yearbook of Statistics Singapore 2007* and *2012*.

Next, intra-national trade data are required. Duval and Utoktham (2012) used the gross output based on shipments to represent the intra-national trade. This is consistent with the export data, which are expressed on the gross shipment basis. However, many countries do not report their gross national output by the manufacturing industry. Therefore the gross national output of the manufacturing industry has to be estimated from the value-added of the manufacturing industry. Duval and Utoktham (2010) estimate gross output of the manufacturing industry from the value added of the manufacturing industry of 73 countries during 1988-2010 by using OLS. They found the gross outputs range from 2.64 to 3.29 of value-added of the manufacturing industry for middle income countries and from 2.07 to 2.73 of value added of the manufacturing industry for high income countries.

Table 3.5 List of country/area

Country/area reports showing gross national output of the manufacturing industry		Country/area reports missing value of gross national output and showing only value-added the manufacturing industry	
Austria	Italy	Australia	Sweden
Belgium	Japan	Indonesia	Switzerland
Canada	Republic of Korea	Malaysia	Taiwan Province of China
Denmark	Netherlands	Singapore	Thailand
France	Philippines		
Germany	Spain		
Hong Kong, China	United Kingdom		
India	United States		

By using data of gross outputs and value-added of the manufacturing industry of country/area on the left hand side of Table 3.2, the coefficient of value-added of the manufacturing industry on gross outputs are between 2.384 and 2.929. Although the multipliers are close to those calculated by Duval and Utoktham (2010), the sample sizes (number of countries/areas) in this paper are much smaller than those from their samples. Therefore, the multipliers from Duval and Utoktham (2010) were used to estimate gross output of manufacturing industry for the country/area on the right hand side of Table 3.2. In order to get the value of domestic shipment or intra-national trade, the gross outputs were subtracted by the manufacturing exports to the world in each country. The manufacturing exports by Singapore in WITS database contain a large re-export value, which reflects the actual value of domestic shipments. Instead of using export data from the WITS database, data of the manufacturing exports by Singapore were taken from the *Yearbook of Statistics Singapore 2007* and *2012*.

The use of comprehensive trade costs has some limitations. First, they are derived solely from international trade and intra-national trade data. Sometimes this does not reflect the real trade situation. For example, trade costs are higher when countries tend to trade more within themselves than they do with others, that is, $\left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)$ as the ratio increases. Trade costs fall when the countries trade more internationally than domestically. Although comprehensive trade costs exhibit this shortcoming, this paper still uses this approach since the calculation is possible by using observable data; with other approaches the problem is the lack of data.

Second, the elasticity of substitution across the manufacturing industry is required in order to estimate trade costs. However, there are no such data available in any database. It is necessary to make an assumption about the elasticity of substitution across the manufacturing industry. Anderson and van Wincoop (2004) estimated the elasticity of substitution and found that it ranges from 5 to 11. Novy (2008) calculates trade cost by setting the elasticity of substitution equal to eight. Following Novy (2008), Duval and Utoktham (2012) and Arvis et al. (2012), the same values of elasticity of substitutions, that is, $\sigma = 8$, are assumed here. The alternative assumptions of elasticity of substitution, that is, $\sigma = 5, 11$, is also used to calculate the comprehensive trade costs of the manufacturing of Thailand and its trading partners. All components are put in equation (3.36) to produce comprehensive trade costs.

3.3.2 Decomposition of Trade Costs

From the concept of comprehensive trade costs, trade costs can be decomposed into different components. Two approaches are used in this paper. First, the comprehensive trade costs are divided into tariff costs and non-tariff costs. Tariff costs, $TC_{ij,t}^{k}$, is geometric average tariff of the manufacturing industry between country *i* and country *j* at time *t* where it is calculated as:

$$TC_{ij,t}^{k} = \sqrt{\left(1 + tc_{ij,t}^{k}\right)\left(1 + tc_{ji,t}^{k}\right)} \tag{3.37}$$

where subscripts *i* and *j* are Thailand and its trading partner countries, respectively. k is the manufacturing industry; $tc_{ij,t}^{k}$ is the weighted average import tariff of the manufacturing industry that country *i* imposes on country *j* at time *t;* and $tc_{ji,t}^{k}$ is the weighted average import tariff of the manufacturing industry that country *j* imposes on country *i* at time *t*. Anderson and van Wincoop (2004) suggested that comprehensive trade costs, excluding tariff costs, are all additional costs other than tariff costs involved in trading goods bilaterally rather than domestically. Comprehensive trade costs excluding tariffs are defined as:

$$NTC_{ij,t}^{k} = \frac{t_{ij,t}^{k}}{TC_{ji,t}^{k}} \tag{3.38}$$

where $NTC_{ij,t}^{k}$ are non-tariff comprehensive trade costs between country *i* and country *j* at time *t*.

Second, trade costs are decomposed based on existing literature such as Anderson and van Wincoop (2004), Jack, et al. (2010) and Duval and Utoktham (2011) who defined trade cost as a function of distance, tariffs, and etcetera. These are as follows:

$$t_{ij,t}^{k} = dist_{ij}^{\beta_1} tariff_{ij,t}^{\beta_2} exch_{ij,t}^{\beta_3}\, doc_{ij,t}^{\beta_4} conec_{ij,t}^{\beta_5}\, exp\left(\beta_0 + \varepsilon_{ij,t}\right) \tag{3.39}$$

The natural logarithm of equation (3.39) yields:

$$lnt_{ij,t}^{k} = \beta_0 + \beta_1 lndist_{ij} + \beta_2 lntariff_{ijt} + \beta_3 lnexch_{ij,t} + \beta_4 lndoc_{ij,t} + \beta_5 lnconec_{ij,t} + \varepsilon_{ij,t} \qquad (3.40)$$

where $t_{ij,t}^{k}$ is comprehensive trade costs between country *i* and country *j* at time *t.* In fact, the data of comprehensive trade costs on the left-hand side are calculated in equation (3.36); $dist_{ij}$ is distance between country *i* and country *j*. The distance is believed to be a factor influencing the transportation cost. Hummels (1999) estimated freight cost as a function of distance to the USA, New Zealand and five Latin American countries. He finds the elasticity of distance on freight cost to be 0.27. For this reason, trade cost is influenced by the distance. $exch_{ij,t}$ is a geometric average of the exchange rate in terms of local currency per USD of country *i* and country *j* at time *t*. The exchange of money from one local currency to foreign currency or vice versa raises both the direct cost (fees) and indirect cost (fluctuation of currency). Trade facilitation factors are the number of documents and times required in the export and import procedures; and $doc_{ij,t}$ is the geometric average of number of documents in the export and import procedures of country *i* and country *j* at time *t* where it is estimated as:

$$doc_{ij,t} = \sqrt{(im\_doc_{i,t} + ex\_doc_{j,t})(im\_doc_{j,t} + ex\_doc_{i,t})} \qquad (3.41)$$

where $ex\_doc_{i,t}$ and $ex\_doc_{j,t}$ are the number of documents required in the export procedure of country *i* and *j* at time *t,* respectively; $im\_doc_{i,t}$ and $im\_doc_{j,t}$ are the number of documents required in the import procedures of country *i* and *j* at time *t,* respectively. The World Bank defines the export documents and import documents as all documents required per shipment that are approved by government ministries, customs authorities, port and container terminals, health and technical control agencies, and banks to export or import goods. The average time required in the process of export and import is calculated in the same manner as calculating the average number of documents. The World Bank defines the time for exporting and importing as the time calculation for a procedure starting from the moment it is initiated and running until it is completed. If a procedure can be accelerated for an additional cost and is available to all trading companies, the fastest legal procedure is chosen. Sea transport time is not included.

$conec_{ij,t}$ is a geometric average of the liner shipping connectivity index between country *i* and country *j* at time *t.* The UNCTAD defines liner shipping connectivity index as how well countries are connected to global shipping network. The index is computed based on five components including number of ships, container-carrying capacity, maximum vessel size, number of services and number of company-deployed container ships in a country's ports. The index ranges from 0 to 100 where the more the value of the index the better the performance of the country to connect to other countries. The data in this section covers 2005-2010 as the World Bank initiated the data collection of trade procedures from 2005. The sources of data in this section are shown in Table 3.6.

Table 3.6 Summary of data sources of trade cost components

Variables	Data source
Distance	CEPII website. Retrieved on February 8, 2013, at http://www.cepii.fr/anglaisgraph/bdd/gravity.asp
Exchange rate	UNCTADSTAT, Retrieved on February 7, 2013, at http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx
Number of documents and time required in the export and import processes	Doing Business. Retrieved on February 7, 2013, at http://www.doingbusiness.org/data
Liner shipping connectivity index	World Databank. Retrieved on February 7, 2013, at http://databank.worldbank.org/data/home.aspx

3.3.3 Impacts of Trade Facilitation on the Manufacturing Exports by Thailand

The augmented gravity model is applied in this paper to analyze the impacts of trade facilitation on the exports of the manufacturing industry. There are two reasons that the AvW model is not used in this paper. First, this study emphasizes only on the manufacturing exports from Thailand to partner countries while the AvW model focuses on trade (export and import), meaning that $X_{ij,t}$ in equation (3.26) should include the export from country i to country *j* where one country can be either country i or *j*. For example, the first data are the exports from Thailand to the USA and next data are the exports from the USA to Japan and so on. Then the data start with the exports from the USA to Thailand and Japan to Thailand and so on. Thus, the impact of trade facilitation on the manufacturing exports of Thailand cannot be specified by using the AvW model. In addition, the AvW model requires information of the elasticity of substitution, which is not found in any statistics office. Therefore, the impacts of trade facilitation on the manufacturing exports of Thailand are defined as follows:

$$lnEX_{ij,t}^{k} = \beta_0 + \beta_1 lnY_{i,t}^{k} + \beta_2 lnY_{j,t}^{k} + \beta_3 lndist_{ij} + \beta_4 lntariff_{ji,t} + \beta_5 lnexch_{ij,t} + \beta_6 lndoc_{ij,t} + \beta_7 lnconec_{ij,t} + crisis + \varepsilon_{ij,t}) \quad (3.42)$$

where subscripts *i* and *j* represent Thailand and its trading partner countries, respectively; k is manufacturing industry; $EX_{ij,t}^{k}$ is the manufacturing exports by Thailand to country *j* at time *t* which defines it in real term. $Y_{i,t}^{k}$ is the real output of the manufacturing industry by Thailand at time *t*; $Y_{j,t}^{k}$ is the real output of the manufacturing industry of country *j* at time *t*; $dist_{ij}$ is the distance from Thailand to country *j;* $tariff_{ji,t}$ is the weighted average import tariff of the manufacturing industry that country *j* imposes to Thailand at time *t;* $exch_{ij,t}$ is the real exchange rate of Thailand and country *j* where it is defined in terms of Thai baht per foreign currency; $doc_{ij,t}$ is a summation of the number of documents required in the export procedure of Thailand at time t and the number of documents required in the import procedure of country j at time *t*; $conec_{ij,t}$ is the average liner shipping connectivity index of country i and country j at time t, respectively; $\varepsilon_{ij,t}$ is the error term. The study employed a panel data of 23 partner countries with Thailand covers the period from 2005 to 2010. Although trade facilitation includes many components, this paper covers only the liner shipping connectivity index and the number of documents and time taken in the export and import procedure.

CHAPTER IV: RESULTS OF TRADE PERFORMANCE, CAPITAL AND LABOR INTENSITY AND PATTERNS OF COMPARATIVE ADVANTAGE OF THE MANUFACTURING INDUSTRY IN THAILAND

The empirical results of this chapter address trade performance of the manufacturing industry in Thailand. First, the result of trade performance indicators are presented in section 4.1 where trade performance indicators are export and import share, market power index, and growth rate of export and import. Then, five export-only RCA indices are presented and compared by using correlation between the value of RCA indices and their ranking. One RCA index is selected as a benchmark to analyze the manufacturing trade of Thailand. The Michelaye index is also estimated to support the results of export-only RCA index. In section 4.2, the industry groups are classified and analyzed based on their performance and capital and labor intensity in order to present the patterns of comparative advantage of the manufacturing industry of Thailand. The discussion based on the results is made in section 4.3.

4.1 Trade Performance

A) Export and Import Shares

The top ten export and import shares of the manufacturing industry of Thailand are presented in this section. Table 4.1 shows the percentage of those ten major export products during 1991-1995, 1996-00, 2001-05, and 2006-10. The top ten major export product groups share around 55% of the total export of the manufacturing industry, but of those ten, the top five shares 40% of the total export of the manufacturing industry in Thailand. The export of processed and preserved meat, fish, fruit, vegetables, oils and fats (151) is in the top major export product groups during 1991-1995; however, the trend of its share decreases over time. After 1995, the number one major export of the manufacturing industry is the manufacture of office equipment and machinery (300) which accounts for

10.55-14.75% of the total export of the manufacturing industry. The second of the top ten major exports is the manufacture of electronic valves and tubes and other electronic components (321). The manufacture of motor vehicle (341) is a remarkable group as it entered the top ten during 2001-2005 and moved to the third position of export shares of the manufacturing industry during 2006-2010.

Table 4.1 Top ten products based on export share

	Top ten 1991-1995		Top ten 1996-2000		Top ten 2001-2005		Top ten 2006-2010	
Rank	Product	%	Product	%	Product	%	Product	%
1	151	13.45%	300	14.75%	300	11.70%	300	10.55%
2	181	9.71%	151	10.26%	321	9.18%	321	6.72%
3	300	9.10%	321	9.05%	151	7.94%	341	6.52%
4	369	7.74%	181	5.18%	241	5.20%	151	6.29%
5	321	6.16%	153	4.90%	323	4.82%	241	6.12%
6	153	5.64%	369	4.69%	341	4.10%	291	4.82%
7	323	4.98%	323	4.61%	291	4.00%	232	4.42%
8	192	3.69%	291	3.32%	369	3.76%	153	4.14%
9	154	3.10%	241	3.07%	153	3.75%	369	3.33%
10	171	3.02%	311	2.63%	181	3.53%	272	3.12%

Source: Author’s calculation, 2013

Turning to the import side, the top ten import shares of the manufacturing industry are present in Table 4.2. The import of special purpose machinery (292) is in the top major import product group during 1991-1995; however, its share dropped steadily over time. The manufacture of electronic valves, tubes and other electronic components (321) dominate the import of the manufacturing industry of Thailand from 1996 to 2010. The import of manufactured basic chemicals (241) shares around 8-9% of total manufacturing imports of Thailand from 1990 to 2010, remaining constantly in the second position. The imports of manufactured basic iron and steel (271) and manufactured basic precious and non-ferrous metals show significant progress during the 1990-2010. Both manufactured products are in the top ten of import shares of the manufacturing industry of Thailand, signifying that these products are extensively used for the manufacturing industry in Thailand. In addition, these products will be used as the intermediated products for other manufacturing industries or in the construction sector.

Table 4.2 Top ten products based on import share

	Top ten 1991-1995		Top ten 1996-2000		Top ten 2001-2005		Top ten 2006-2010	
Rank	Product	%	Product	%	Product	%	Product	%
1	292	9.80%	321	14.46%	321	13.40%	321	9.84%
2	271	8.67%	241	7.90%	241	8.29%	241	9.23%
3	241	8.06%	292	7.17%	271	6.99%	271	8.78%
4	321	7.59%	271	6.22%	300	6.26%	272	8.36%
5	291	7.03%	300	5.99%	292	6.10%	242	6.16%
6	341	5.51%	291	5.63%	291	5.21%	291	5.48%
7	300	4.62%	242	4.94%	242	5.14%	300	5.25%
8	242	4.30%	289	4.32%	272	4.86%	292	5.13%
9	151	3.27%	272	3.55%	343	3.83%	343	3.58%
10	272	3.02%	151	2.93%	289	3.52%	289	3.40%

Source: Author's calculation, 2013

B) Market Power Index

The top ten of the market power index or share of export products in the world market of manufacturing products is demonstrated in Table 4.3. The manufacture of grain mill products, starches and starch products, and prepared animal feeds (153) has strong market power in the world market, accounting for 10.12% to 19.09% in the world market. The export of processed and preserved meat, fish, fruit, vegetables, oils and fats (151) shares around 3-6% of the world market, although it is number one in the major export product of Thailand. Other product groups have only small power in the world market.

Table 4.3 Top ten products based on market power index

	Top ten 1991-1995		Top ten 1996-2000		Top ten 2001-2005		Top ten 2006-2010	
Rank	Product	%	Product	%	Product	%	Product	%
1	153	19.09%	153	11.36%	153	10.12%	153	12.46%
2	192	7.01%	151	3.80%	151	3.32%	251	4.41%
3	369	6.97%	191	3.25%	243	3.00%	243	4.18%
4	191	6.42%	300	2.72%	251	2.72%	300	4.03%
5	151	6.39%	369	2.68%	300	2.45%	359	3.25%
6	181	6.27%	311	2.66%	311	2.37%	151	3.19%
7	154	4.60%	192	2.64%	369	2.30%	293	2.62%
8	173	3.73%	154	2.43%	323	2.30%	321	2.62%
9	323	3.08%	323	2.34%	321	2.28%	154	2.59%
10	333	3.24%	333	2.21%	333	2.25%	369	2.59%

Source: Author's calculation, 2013

C) Growth of Exports and Imports

This section shows the export growth of key product groups. The selection of these groups is based on the significance of the product groups in term of export share, market power index, and RCA. Therefore, this section mainly focuses on product groups 151, 153, 300, 321, and 323, which are major exports and have a high market share in the world market products. The discussion also focuses on the product groups which have RCA changing from lower than unity (comparative disadvantage) to more than unity (comparative advantage) such as product groups 241, 281, 291, 341, and 343. The export of manufacturing products grew on average at 20.89% per year during 1990-1995 (see Table 4.4). The impact of the Asian financial crisis reduced the export of manufacturing to negative growth in 1998. Out of 57 manufacturing products groups, 39 product groups face a severe situation in negative growth in 1998. After the crisis, the export of manufacturing rapidly rebounded to positive growth during 2001-2010. The manufacture of office equipment and machinery (300) drops in export growth from 29.95% to 9.27% following the crisis. The growth rate of exports of manufactured motor vehicles (341) and manufactured parts and accessories for motor vehicles (343) has an average growth of around 38.10% and 37.89% per year during 1991-2010. The Government of Thailand implemented policies to promote the motor vehicle sector during early 1990s; as a result, this sector shifted from being import-oriented to export-oriented in 1996.

Table 4.4 Average growth of the manufacturing export

Code/Year	1991-95	1996-00	2001-05	2006-10	1991-10
Manufacturing	20.89%	4.66%	10.21%	13.37%	12.28%
151	13.82%	0.46%	2.80%	11.54%	7.16%
153	13.16%	-1.97%	9.31%	19.89%	10.10%
241	42.65%	34.87%	19.63%	12.99%	27.54%
281	11.06%	3.90%	26.19%	30.66%	17.95%
291	33.70%	4.78%	17.65%	17.30%	18.36%
300	29.95%	9.27%	6.44%	8.49%	13.54%
321	30.13%	15.55%	3.38%	7.11%	14.04%
323	24.49%	4.70%	10.24%	2.21%	10.41%
341	27.97%	73.31%	26.35%	24.77%	38.10%
343	68.04%	30.83%	35.50%	17.20%	37.89%

Source: Author’s calculation, 2013

The average growth rate of the manufacturing imports is around 17.73% during the 1991-1995 corresponding with the average growth rate of the manufacturing exports. The Asian financial crisis in 1997 impacted not only the manufacturing exports but also the manufacturing imports. The growth rate of the manufacturing imports during the crisis became negative. Out of 57 product groups, 54 faced negative growth rates in the manufacturing imports of Thailand. Most of the manufacturing industries recovered from the crisis in the early 2000s. Since then the manufacturing imports have had an average growth rate of around 10-12% per year. At the product group level, the growth rates of the manufacturing imports of products 281 and 343 are on average 21% per year.

Table 4.5 Average growth of the manufacturing imports

Code/Year	1991-95	1996-00	2001-05	2006-10	1991-10
Manufacturing	17.73%	-1.42%	12.70%	11.52%	10.13%
151	6.00%	0.78%	11.35%	13.55%	7.92%
153	19.07%	-0.07%	10.85%	15.26%	11.28%
241	16.63%	-2.59%	14.58%	14.83%	10.86%
281	30.89%	-19.07%	35.24%	40.63%	21.92%
291	25.48%	-8.81%	17.16%	10.61%	11.11%
300	14.89%	-6.16%	12.84%	9.04%	7.65%
321	32.21%	10.90%	3.43%	5.63%	13.04%
323	18.66%	-4.00%	16.18%	13.82%	11.17%
341	12.26%	-2.01%	16.76%	20.74%	11.94%
343	24.86%	27.12%	15.16%	17.47%	21.15%

Source: Author’s calculation, 2013

D) Comparison of Revealed Comparative Advantage Indices

Six RCA indices are calculated for 57 product groups in the manufacturing industry in Thailand from 1990 to 2010. Firstly, the number of industries with comparative advantage and number of industries with comparative disadvantage for the six RCA indices are investigated (see Table 4.6). The export-only RCA indices except WRCA are identical in terms of number of industries with comparative advantage and comparative disadvantage. On the other hand, MRCA is slightly different with export-only RCA indices in terms of the number of industries with comparative advantage and with comparative disadvantage. The statistical summary of the average of five years for the six RCA indices from 1991 to 2010 is presented in Table A.2 in Appendix A. In this section five RCA indices are compared while the MRCA index is discussed in the next section. As discussed in section 3.1.2, zero mean of ARCA and NRCA are confirmed while the SRCA, BRCA, and WRCA suffer from unstable means.

Table 4.6 Number of industries with comparative advantage and comparative disadvantage

RCA	Description	91-95	96-00	01-05	06-10
BRCA	No. of industries with comparative advantage	26	20	22	20
	No. of industries with comparative disadvantage	31	37	35	37
SRCA	No. of industries with comparative advantage	26	20	22	20
	No. of industries with comparative disadvantage	31	37	35	37
WRCA	No. of industries with comparative advantage	20	20	22	19
	No. of industries with comparative disadvantage	37	37	35	38
ARCA	No. of industries with comparative advantage	26	20	22	20
	No. of industries with comparative disadvantage	31	37	35	37
NRCA	No. of industries with comparative advantage	26	20	22	20
	No. of industries with comparative disadvantage	31	37	35	37
MRCA	No. of industries with comparative advantage	24	26	28	26
	No. of industries with comparative disadvantage	32	30	28	30

Source: Author's calculation, 2013

The second approach to compare five RCA indices is to calculate the correlations between the value of RCA indices and their ranks across industries and across years (see Table 4.7). The correlation between SRCA and its ranking is the highest in the pooled sample and the average across the industries. The rank correlation of ARCA is the highest when it is averaged across the years. On the other hand, the BRCA has the lowest correlation in all categories.

Table 4.7 Correlation between RCA indices and their ranks

Export-only RCA	BRCA	SRCA	WRCA	ARCA	NRCA
Pooled sample	0.696	0.978	0.712	0.804	0.786
Average across industries	0.725	0.985	0.725	0.827	0.827
Average across years	0.921	0.937	0.926	0.945	0.921

Source: Author's calculation, 2013

Table 4.8 Percentages of rank correlation individual years across industries

Correlation interval	BRCA	SRCA	WRCA	ARCA	NRCA
$100 \geq \rho > 95$	0.00	100.00	0.00	0.00	0.00
$95 \geq \rho > 90$	0.00	0.00	0.00	0.00	0.00
$90 \geq \rho > 85$	0.00	0.00	0.00	14.29	14.29
$85 \geq \rho > 80$	0.00	0.00	0.00	71.42	71.42
$80 \geq \rho > 75$	28.57	0.00	28.57	14.29	14.29
$75 \geq \rho > 70$	23.81	0.00	52.38	0.00	0.00
$70 \geq \rho$	47.62	0.00	19.05	0.00	0.00

Source: Author's calculation, 2013

Table 4.9 Percentages of rank correlation individual industries across years

Correlation interval	BRCA	SRCA	WRCA	ARCA	NRCA
$100 \geq \rho > 95$	61.40	61.40	63.16	40.35	71.93
$95 \geq \rho > 90$	12.28	21.06	12.28	36.84	8.77
$90 \geq \rho > 85$	7.02	10.52	7.02	12.28	12.28
$85 \geq \rho > 80$	7.02	0.00	10.52	5.26	3.51
$80 \geq \rho > 75$	5.26	3.51	0.00	0.00	0.00
$75 \geq \rho > 70$	3.51	1.76	3.51	5.26	3.51
$70 \geq \rho$	3.51	1.75	1.75	0.00	0.00

Source: Author calculation, 2013

The summary percentages of rank correlation for individual years across industries are presented in Table 4.8. The rows show that percentages of the rank correlation (ρ) fall into indicated intervals. All of the correlations between SRCA and its ranks are above the 95 interval. On the other hand, BRCA has the lowest rank correlation across industries. About 40% of rank correlation of BRCA is in the 65-70 intervals. It is remarkable that rank correlations of ARCA and NRCA provide identical percentages in each interval.

Table 4.9 shows percentage of rank correlation for individual industries for the five RCA indices across years. The percentage of rank correlation of NRCA is highest when the correlation is in 95-100 intervals. In addition, the lowest rank correlation of NRCA is in 70-75 intervals. However, the percentage of rank correlation of SRCA is highest when the interval of correlation is from 90 to 100. Based on the correlation of RCA indices and their ranks in Table 4.7, 4.8 and 4.9, SRCA seem to be the best indicator of comparative advantage to compare across industries and over time. For this reason, the SRCA is used in this study in order to analyze the comparative advantage of the manufacturing industry of Thailand.

Table 4.10 Top ten products with highest SRCA

	Top ten 1991-1995		Top ten 1996-2000		Top ten 2001-2005		Top ten 2006-2010	
Rank	Product	SRCA	Product	SRCA	Product	SRCA	Product	SRCA
1	153	0.825	153	0.810	153	0.784	153	0.783
2	192	0.593	151	0.522	151	0.458	251	0.483
3	369	0.584	191	0.463	243	0.417	243	0.458
4	151	0.560	300	0.389	251	0.380	300	0.453
5	191	0.553	311	0.380	300	0.334	359	0.361
6	181	0.540	369	0.372	311	0.312	151	0.358
7	154	0.423	192	0.369	369	0.307	293	0..270
8	173	0.304	154	0.333	323	0.305	321	0.263

9	333	0.290	323	0.324	321	0.303	369	0.260
10	323	0.271	181	0.296	333	0.294	154	0.257

Source: Author's calculation, 2013

Out of 57 product groups of manufactured products in Thailand, 26 product groups have comparative advantage (SRCA>0) during 1991-1995. However, the number of product groups which have comparative advantage drops to 20 during 2006-2010. Furthermore, many product groups had comparative advantage during the 1990s such as product groups 181, 191 and 192, but lost their comparative advantage in the late 2000s. The top ten product groups with the highest SRCA are summarized in Table 4.10. The manufacture of grain mill products, starches and starch products, and prepared animal feeds (153) has the highest SRCA which is around 0.783 to 0.825. The manufacture of rubber products (251) has a strong comparative advantage during 2006-2010, although the share of the export of this product is only 2% of the total export of manufactured products of Thailand and around 3% of the world market.

E) Michelaye RCA

MRCA indices are calculated in order to discuss the results of export-only RCA. Firstly, the summary of MRCA indices is shown in Table A.2 in Appendix A. The correlation between SRCA and MRCA is 0.497. Table 4.11 shows the top ten highest MRCA. In most cases the SRCA and MRCA are consistent in terms of comparative advantage and comparative disadvantage. However, there are some cases having a significant difference in comparative advantage between the two indices. For example, the manufacture of refined petroleum products (232) has comparative disadvantage in SRCA (SRCA < 0) while it has comparative advantage in MRCA (MRCA > 0). The other case is the manufacture of electronic valves and tubes and other electronic components (321) which has comparative advantage in SRCA (SRCA > 0) while it has comparative disadvantage in MRCA (MRCA < 0).

Table 4.11 Top ten products with highest MRCA

	Top ten 1991-1995		Top ten 1996-2000		Top ten 2001-2005		Top ten 2006-2010	
Rank	Product	MRCA	Product	MRCA	Product	MRCA	Product	MRCA
1	151	0.102	300	0.088	300	0.054	300	0.053
2	181	0.096	151	0.073	151	0.051	341	0.049
3	153	0.054	181	0.050	153	0.035	153	0.038
4	369	0.053	153	0.046	181	0.034	151	0.035
5	300	0.045	369	0.032	323	0.031	232	0.025
6	192	0.036	323	0.030	341	0.027	251	0.023
7	154	0.028	154	0.022	369	0.021	369	0.019
8	323	0.027	192	0.018	154	0.016	154	0.016
9	361	0.015	361	0.013	251	0.014	181	0.016
10	173	0.013	251	0.010	293	0.014	293	0.014

Source: Author's calculation, 2013

4.2 Capital and Labor Intensity and Patterns of Comparative Advantage

From the comparison of RCA indices and MRCA, SRCA is selected as a benchmark to analyze the capital and labor intensity and patterns of comparative advantage. In order to capture the trend and patterns of comparative advantage during 1991-2010, SRCA of the manufacturing industry is classified into four groups based on capital and labor intensity. These are: high capital-intensive industry, medium-high capital-intensive industry, medium-high labor-intensive industry and high labor-intensive industry (see Table A.3 in Appendix A). The industries are ranked by using the capital-labor ratio, where the top of the table indicates the highest capital-intensive industry and the bottom of the table indicates the highest labor-intensive industry. Then, trend analysis is used to indicate the patterns of SRCA based on capital and labor intensity.

The first group is high capital-intensive industries. Out of 13 industries, five exhibit comparative advantage (SRCA > 0) and eight industries have increased their comparative advantage. The second group is medium high capital-intensive industries. In this group, 12 of 14 industries have comparative disadvantage (SRCA < 0), but half of the whole group have improved their comparative advantage. The third group is medium high labor-intensive industries with half of the industries having comparative advantage (SRCA > 0) and six of the total 14 industries have increased their comparative advantage. The last group is high labor-intensive industries. There are 13 industries in this group. Most products in this group have comparative advantage during the 1990s but have comparative disadvantage (SRCA < 0) during the 2000s (see Table A.3 in Appendix A).

From the information in Table A.3 in Appendix A, the manufacturing industries are classified again based on their comparative advantage and trends (see Table A.4 in Appendix A). There are seven groups from A to H. Group A contains products achieving comparative advantage status (SRCA > 0), which exhibits an increase during 1991-2010. The main products in this group are mainly high capital-intensive and medium high capital-intensive products except for manufacture of domestic appliances n.e.c. (293) and manufacture of transport equipment (359). Group B contains products achieving comparative advantage (SRCA > 0), but the trend of SRCA in this group has decreased over time. The main products in this group are mixed between labor-intensive industries and capital-intensive industries. Group C contains products with comparative advantage during 1991-05, but comparative disadvantage during 2006-2010. Most of products in this group are labor-intensive industries such as manufacture of other textiles (172), manufacture of knitted and crocheted products (173), manufacture of wearing apparel, except fur apparel (181), tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness (191), and manufacture of footwear (192). Group D is the group of products with comparative advantage (SRCA > 0) and stable trends over time.

Group E is a group of products having comparative disadvantage (SRCA < 0), but the trend of products in this group is increasing. There are 16 products in this group. Most of the products in this group are from the high and medium high capital-intensive industry except for manufacture of tobacco product (160), manufacture of sawmilling and planning of wood (201) and manufacture of medical appliances and instruments (331). The manufacture of motor vehicles (341) and manufacture of parts and accessories for motor vehicle (343) has demonstrated a remarkable increase in SRCA, gaining comparative advantage in the late 2000s.

Group F contains products having SRCA lower than zero with decreasing trend over time. There are two products in this group, namely, printing and service activities related to printing (222) and manufacture of television and radio transmitters (322). Group G contains products having SRCA lower than zero and their trend is constant. Group H contains products in which SRCA changes from lower than zero during 1990-05 to higher than zero during 2006-10. This group is comprised of three products, which are the manufacture of publishing (221), the manufacture of basic chemicals (241), and the manufacture of structural metal products, tanks, reservoirs and steam generators (281).

The second approach to demonstrate the role of capital and labor intensity in comparative advantage of the manufacturing industry in Thailand is the multi-factors cross sectional analysis and logit regression. The multi-factors model (3.12) was regressed by using OLS for two years, 1996 and 2006. The Breusch-Pagan test for heteroskedasticity was employed for both years. Heteroskedasticity was found in 2006. The robust standard error was used to remediate the heteroskedasticity. However, the result of robust standard error did not change the sign of the coefficient and the significant result in OLS. Skilled labor and unskilled labor may correlate and cause a multicollinearity problem. The model (3.12) was regressed twice, with two factor and three factors. The significance and sign of the coefficient did not change in both regressions. Thus, there is no issue of multicollinearity. The results of model (3.12) are shown in Table 4.12.

In 1996, the results of model (3.12) show that the coefficient of capital is negatively significant at the 5% level and the coefficient of labor is positively significant at the 1% level. The manufacturing industry is exporting labor-intensive goods and importing capital-intensive goods. In addition, the coefficient of unskilled labor is positively significant at the 1% level while the coefficient of skilled labor is insignificant in the model which means that the manufacturing industry in Thailand is actually exporting unskilled labor-intensive goods.

Table 4.12 Regression results of model 3.12

Year	K	L	USKL	SKL	N	R^2
1996	-0.481	0.562			54	0.281
	(0.233)**	(0.142)***				
	-0.469		0.614	0.139	54	0.283
	(0.248)***		(0.191)***	(1.441)		
2006	-0.260	0.353			56	0.067
	(0.027)	(0.181)*				
	-0.131		0.721	-3.550	56	0.087
	(0.255)		(0.392)*	(3.697)		

Note: Figures in parenthesis are standard errors

* p<0.10, ** p<0.05, *** p<0.01

In 2006, the coefficient of labor is negatively significant at the 10% level. This means the manufacturing industry is exporting labor-intensive goods. The coefficient of capital is negative but not significant, so it is not obvious that the manufacturing industry is an importer of capital-intensive goods in 2006. The coefficient of unskilled labor is significant at the 10% level while the coefficient of skilled labor is negatively insignificant. Therefore, the manufacturing industry exports unskilled labor.

For the logistic regression, net export was replaced by a binary variable (1 is the net exporter, and 0 is the net importer). The logistic regression results are shown in Table 4.13.

The sign of the coefficient of the capital-labor ratio is negative in 1996 and 2006, but is not statistically significant in either year. The coefficient of the ratio of skilled labor to total labor is negatively significant in both years. This means the manufacturing industry is an exporter of unskilled labor-intensive goods. In 2006, the availability of data allows labor to be classified into two levels, skilled labor (SE) and medium skilled labor (MSE). Equation (3.14) was regressed again with SE and MSE; however, the coefficient of the medium skilled labor ratio is not significant.

Table 4.13 Logistic regression results of equation 3.14

Year	KL	SE	MSE	N	Pseudo R^2
1996	-0.518	-15.098		54	0.173
	(-0.802)	(6.171)**			
2006	-0.017	-25.974		56	0.214
	(0.222)	(8.537)***			
	-0.009	-24.512	-2.322	56	0.222
	(0.224)	(8.591)***	(3.032)		

Note: Figures in parenthesis are standard errors

* $p<0.10$, ** $p<0.05$, *** $p < 0.01$

From the results in Tables 4.12 and 4.13, it can be concluded that the manufacturing industry of Thailand has a comparative advantage in labor-intensive goods and a comparative disadvantage in capital-intensive goods in 1996. Although the manufacturing industry has a comparative advantage in labor-intensive goods, it is in medium and unskilled labor not skilled labor. The result is reasonable since the labor-intensive goods play an important role in the share of export and comparative advantage of the manufacturing industry. For example, the product groups 300 and 151 are the first and the second highest major exports of the manufacturing industry during 1996-2000 (see Table 4.1). In addition, the product groups 151 and 153 have a very high comparative advantage during 1996-2000.

The absolute value of a coefficient of capital in Table 4.12 becomes smaller in 2006. Furthermore, the absolute coefficient of the capital-labor ratio in 2006 is smaller than it is in 1996 (see Table 4.13). From this result, the manufacturing industry is in a transition process of moving from a labor-intensive industry to a capital-intensive industry. The evidence can be supported by the results of the previous section. The capital-intensive industries play more important roles in export in the late 2000s. The industries in group G (see Table A.4 in Appendix A) such as publishing (221), manufacture of basic chemicals (241), and manufacture of structural products (281), and this group have comparative advantage in the present year.

4.3 Discussion

The study presents the results of the export performance of the manufacturing industry in Thailand. The exports of the manufacturing industry are dominated by the labor-intensive product groups as indicated in Table 4.1. However, capital-intensive goods have become more important in recent years since the share of product groups 241 and 341 moved from not placing in the top ten in 1990-1995 to the fifth and the third rank during 2006-2010, respectively. Although the country experienced the Asian financial crisis, it had only a slight impact on the exports of the manufacturing industry in Thailand. Major trading partners like Japan and the United States did not endure any impacts from the crisis in 1997; therefore, the growth of exports of the manufacturing industry performs very well as its growth rate is 10-13% per year during 2000-2010.

The comparison of six RCA indices suggests that they are consistent in terms of comparative advantage and comparative disadvantage. However, none of them satisfies statistical properties that would allow them to be used in comparison across space and time. By using the correlation technique, SRCA seem to be the ideal RCA index since it has the highest correlations between the values of index and its ranking across industry and time. Although the SRCA emphasizes only the role of export, the trade-cum RCA, MRCA, is consistent with SRCA in terms of number of industries with comparative advantage and comparative disadvantage. The top ten industries with highest SRCA in Table 4.10 imply that the labor-intensive industries play an important role in the 1990s while the capital-intensive industries make significant progress in their comparative advantage in 2000s. When classifying the products into a group based on capital and labor intensity, the manufacturing industry again shows strong comparative advantage in the labor-intensive goods in the 1990s, but the trend is decreasing over time. On the other hand, the capital-intensive goods contain a strong comparative advantage, especially product groups D and G (see Table A.4 in Appendix A), which include manufacture of parts and accessories for motor vehicles and manufacture of general purpose machinery.

In order to find the role of capital and labor intensity in the manufacturing trade, two approaches are used in this paper. The first approach applies the multi factors model (3.12) and logit regression (3.14) to predict the direction of trade. The results show that the manufacturing industry in Thailand is an exporter of labor-intensive goods which uses medium and low skilled labor. The results also indicate that Thailand is an importer of capital-intensive manufacturing goods. In line with the results of SRCA, it can be concluded that the manufacturing industry in Thailand has relative comparative advantage in medium skilled labor-intensive goods and has a relative comparative disadvantage in capital and skilled labor-intensive goods during 1990s. The turning point came after the country had recovered from the crisis in 1997; the country began to export many capital-intensive manufacturing goods.

The pattern of comparative advantage and the manufacturing trade of Thailand is moving from labor-intensive goods to capital-intensive goods as explained in the flying geese paradigm and product life cycle. Akamatsu (1962) explained the flying geese paradigm of East Asia based on dynamic comparative advantage. The leader of the flying geese is Japan. The second tier of nations comprises South Korea, Taiwan, Singapore and Hong Kong and the third tier of nations is Thailand, Malaysia, the Philippines and

Indonesia. Japan, Taiwan, and Korea are good examples of this pattern of development. In the early stage of economic development, the garment and textile industries, labor-intensive industry, were important sectors in their economies. Later, they became diversified into more advanced technology such as electronics, steel, and automobile industries, capital-intensive industries. The same pattern can be explained for the export of the manufacturing industry of Thailand. In the early 1990s, the export of the manufacturing industry was dominated by labor-intensive industries such as the foods processing industry and textile industry. However, during 2000-2007 the export of motor vehicle and electronics increased rapidly. The product life cycle also supports the pattern of trade of the manufacturing industry in Thailand. There are five stages of the product life cycle: introduction, growth, maturity, saturation and decline (Vernon, 1966). The export share and market share of many labor-intensive manufacturing goods are in the declining stage because the increased labor cost reduces their competitiveness. On the other hand, many capital-intensive goods are in the growth stage.

As the capital-intensive industries began to play more important roles in the manufacturing industry in Thailand in the 2000s, the reason for the significant progress in term of output and export must be explained. FDI from many countries is one of the factors influencing the patterns of comparative advantage of the manufacturing industry in Thailand. FDI from Japan, the most important trading partner and source FDI, shares around 40-70% each year during the 2000s and, of these shares, more than 50-70% are concentrated in the capital-intensive industries such as manufacture of machinery and equipments (29), manufacture of radio, television, communication equipments (32) and manufacture of vehicle, trailers and semi-trailers (33) (see Table B.7 and B.8 in Appendix B). These product groups gain comparative advantage and their trends increase over time. The impact of FDI on the manufacturing trade from this aspect will be discussed in the next chapter.

CHAPTER V: RESULTS OF IMPACTS OF FDI ON THE MANUFACTURING TRADE OF THAILAND

This chapter presents the results of the impact of FDI on the manufacturing trade of Thailand from the perspective of three directions of impacts as discussed in Chapter II section 2.2. The first direction is the result of impact of FDI on the manufacturing exports from Thailand to source countries. The second direction is the impact of FDI on the manufacturing exports from Thailand to other countries. The final direction is the impact of FDI on the manufacturing imports of Thailand from source countries. The chapter ends with discussion.

5.1 Impacts of FDI on the Manufacturing Trade of Thailand

This section investigates the impacts of FDI on the exports of the manufacturing industry from Thailand to source countries. The study applies panel data of 22 source countries from 1999 to 2010. The descriptive statistics of variables are summarized in Table B.1 in Appendix B. The panel data is estimated by using the pooled least squares (LS), the fixed effect model (FE) and the random effected (RE) model. The decision on which model to use, the FE model or the RE model, is made by the Hausman test. The Hausman test is applied where the null hypothesis is preferred to the RE model. The result suggests that the null hypothesis is not rejected (see Table B.2 in Appendix B). Therefore, the RE model is preferred. In addition, the gravity model includes a time invariant variable, i.e. distance; as a result, the fixed effect model is not appropriate.

Then, the Breusch-Pagan Lagrange Multiplier (LM) test is applied in order to decide between the RE model or the pooled LS. The null hypothesis of the Breusch-Pagan LM test is that variance across entities is zero. In other words, there is no significant difference across units (countries). According to the result of the Breusch-Pagan LM test, the null hypothesis is rejected ($p\text{-value} < 0.01$) and it is concluded that there are significant differences across the countries (see Table B.3 in Appendix B). The endogenous problem may arise in the RE model because the assumption of the RE model is that individual specific error correlates with the same independent variables. If this is the case, the random effect model is inconsistent. The Hausman-Taylor estimator is an instrumental variable estimator used to solve the problem of inconsistency in the RE model. Here $lnGDP_{j,t}$ is assumed to correlate with the random effects. The fixed effect transformation of $\widetilde{lnGDP}_{j,t} = lnGDP_{j,t} - \overline{lnGDP_{j,t}}$ ($\overline{lnGDP_{i,t}}$ is the average of $lnGDP_{i,t}$ over time) eliminates the correlation with the random effect; therefore, $\widetilde{lnGDP}_{j,t}$ is a suitable instrument for $lnGDP_{j,t}$.

Table 5.1 Impacts of FDI on the manufacturing exports to source countries

Variable	Pooled LS	FE	RE	Hausman-Taylor
$lnGDP_{i,t}$	2.156***	2.331***	2.366***	2.359***
	(0.251)	(0.158)	(0.117)	(0.127)
$lnGDP_{j,t}$	0.909***	1.001**	0.913***	0.931***
	(0.039)	(0.220)	(0.100)	(0.135)
$lnDIS_{ij}$	-1.506***		-1.559***	-1.583***
	(0.060)		(0.200)	(0.237)
$lnT_{ji,t}$	-8.458***	-3.906***	-4.434***	-4.345***
	(0.522)	(0.363)	(0.635)	(0.675)
$lnEXCH_{ij,t}$	-0.086***	-0.223*	-0.126**	-0.131**
	(0.013)	(0.130)	(0.049)	(0.054)
$lnFDI_{ji,t}$	0.056***	0.005	0.006	0.006
	(0.020)	(0.011)	(0.010)	(0.010)
D_{gfc}	0.033	0.085**	0.078**	0.079**
	(0.089)	(0.036)	(0.036)	(0.035)
Cons	-17.635***	-34.246***	-19.874***	-19.829***
	(2.998)	(2.062)	(1.912)	(2.038)
N	264	264	264	264
R^2	0.843	0.891	0.891	

Note: Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01

Table 5.2 shows results of the impacts of FDI on the manufacturing exports of Thailand to source countries using the pooled LS, the FE model, the RE model, and the Hausman-Taylor estimator. The coefficients of independent variables are slightly different among the three models except for the coefficient of tariff. The interpretation of coefficients is based on the Hausman-Taylor estimator. In general, the coefficient of independent variables provides the correct sign: the coefficients of GDP of host and source country are positively significant at the 1% level while the coefficients of distance, tariff, and exchange rate are negatively significant at the 1% level and the 5% level respectively.

Table 5.2 Impacts of FDI on the manufacturing exports to other countries

Variable	Pooled LS	FE	RE	Hausman-Taylor
$lnGDP_{i,t}$	1.910***	1.667***	1.817***	1.847***
	(0.175)	(0.287)	(0.197)	(0.233)
$lnGDP_{oj,t}$	0.589***	0.755***	0.609***	0.853***
	(0.047)	(0.154)	(0.042)	(0.098)
$lnDIS_{ioj}$	-1.122***		-1.282***	-2.301***
	(0.299)		(0.383)	(0.628)
$lnT_{joi,t}$	-3.911**	-7.444**	-5.107**	-5.700**
	(1.786)	(2.967)	(2.083)	(2.441)
$lnREER_{ij,t}$	-0.352***	-0.454**	-0.377**	-0.413**
	(0.129)	(0.180)	(0.177)	(0.179)
$lnFDI_{ji,t}$	0.005	0.021***	0.009**	0.020***
	(0.004)	(0.006)	(0.004)	(0.005)
D_{gfc}	0.266***	0.267***	0.263***	0.279***
	(0.031)	(0.038)	(0.035)	(0.036)
Cons	-12.751***	-22.096***	-10.486**	-5.540
	(3.579)	(5.064)	(4.320)	(5.747)
N	264	264	264	264

R^2	0.934	0.940	0.938

Note: Standard errors in parentheses, * p<0.1, ** p<0.05, ***p<0.01

The coefficients of the gravity model are interpreted as the elasticity. For example, the coefficient of GDP of a source country is positively significant at the 1% level which indicates that a 1% increase of GDP of country *j* increases the manufacturing exports from Thailand to country *j* by 2.359%. One important stylized fact is that the impact of tariff on export is relatively high compared to the impact of other variables. The coefficient of tariff indicates that a 1% decrease of import tariff of country *j* increases the manufacturing exports of Thailand by 4.345%. However, there is no significant impact of FDI on the manufacturing exports from Thailand to source countries. Interestingly, the coefficient of dummy for the global financial crisis in 2007 has a positive impact on the manufacturing exports from Thailand to source countries which indicates that the manufacturing exports in the post-crisis are higher than pre crisis.

The results of the impact of FDI on the manufacturing exports of Thailand to other countries are shown in table 5.2. Although the results of the Hausman test suggest that the FE model is appropriate, the coefficient of distance cannot be observed since the distance is a time invariant variable (see Table B.4 in Appendix B). Therefore, the RE model has been applied. As mentioned above, the RE model is inconsistent. The explanation of coefficients is based on result of the Hausman-Taylor estimator. In general, the independent variables provide correct signs: the coefficients of GDP of country *i* and weighted average GDP of other countries except country *j* are positively significant at the 1% level while the coefficients of weighted average distance of other countries except country *j*, real effective exchange rate and average tariff of other countries except country *j* are negatively significant at the 1% and 5% level respectively. The coefficient of FDI is positively significant at the 1% level.

The results of the impacts of FDI on the manufacturing imports of Thailand are shown in Table 5.3. The results of the Hausman and the Breusch-Pagan LM test suggest that the RE model is appropriate (see Table B.5 and B.6 in Appendix B). The explanation of coefficients is based on the result of the Hausman-Taylor estimator. In general, the coefficient of independent variables provides the correct sign: the coefficients GDP of host and source country is positively significant at the 1% level while the coefficient of distance is negatively significant at the 1% level. However, there are no significant impacts from import tariff, bilateral exchange, and dummy for crisis on the manufacturing imports of Thailand. FDI has positive impacts on the manufacturing imports of Thailand.

Table 5.3 Impacts of FDI on the manufacturing imports of Thailand

Variable	Pooled LS	FE	RE	Hausman-Taylor
$lnGDP_{i,t}$	1.851***	2.518***	2.675***	2.513***
	(0.413)	(0.159)	(0.143)	(0.153)
$lnGDP_{j,t}$	0.818***	1.341**	1.116***	1.340***
	(0.037)	(0.142)	(0.098)	(0.130)
$lnDIS_{ij}$	-1.255***		-1.811***	-2.068***
	(0.110)		(0.219)	(0.305)
$lnT_{ij,t}$	-5.902***	-0.147	-0.134	-0.190
	(1.606)	(0.446)	(0.460)	(0.446)
$lnEXCH_{ij,t}$	-0.002	-0.163	-0.064	-0.099
	(0.018)	(0.114)	(0.053)	(0.069)
$lnFDI_{ji,t}$	0.034***	0.017**	0.019**	0.017**
	(0.006)	(0.010)	(0.010)	(0.010)
D_{gfc}	-0.043	0.010	0.008	0.007
	(0.119)	(0.033)	(0.034)	(0.033)
Cons	-15.032***	-41.657***	-24.744***	-23.659***
	(4.728)	(1.607)	(2.230)	(2.762)
N	264	264	264	264
R^2	0.783	0.909	0.907	

Note: Standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01

5.2 Discussion

The coefficients of variables such as GDP of the source countries and Thailand and distance in Table (5.1) and (5.3) are consistent with previous studies of the gravity model; for example, Ross and Wincoop (2001), Prabir (2006), Xuan and Xing (2006), Chaisrisawatsuk and Chaisirsawatsuk, (2007) in terms of their impacts on exports. The distance reflects the transportation costs; as a result, Thailand has more trade with closer countries than farther countries. The elasticity of tariff has strong impact on the manufacturing exports because tariff rates have direct impact on the export and import price of manufacturing products. This is the reason why the Government of Thailand continues to negotiate more free trade agreements with trading partners at the bilateral and multilateral levels.

Figure 5.1 Tariff rates of five major trading partner countries

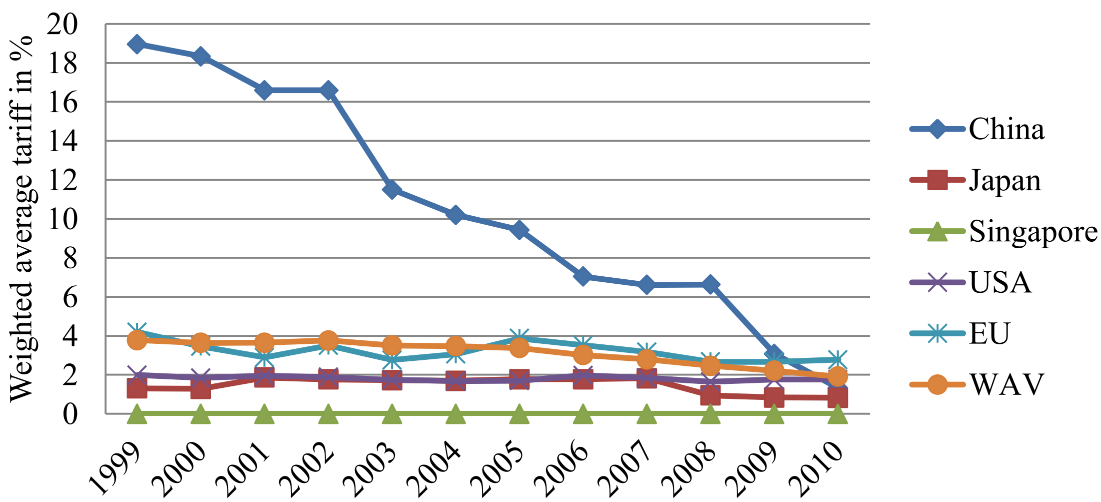


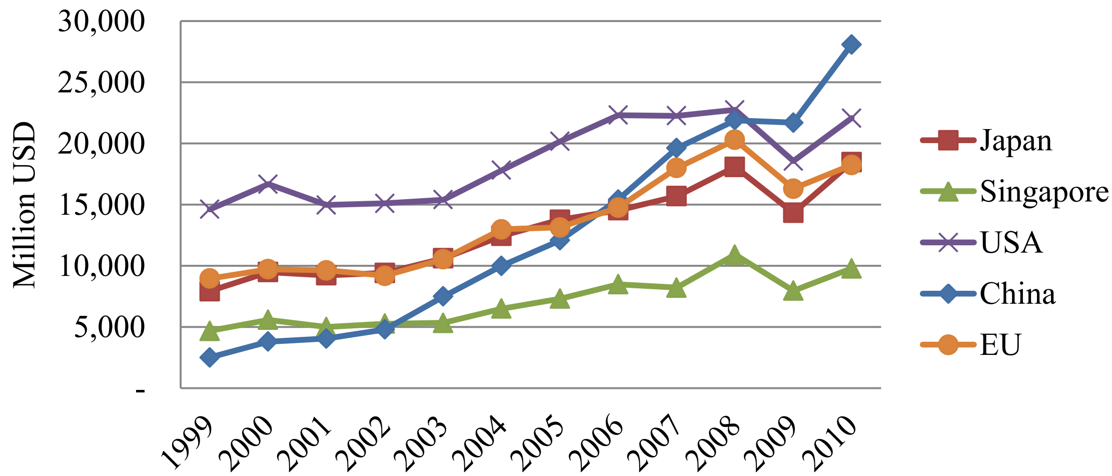
Figure 5.1 shows the weighted average import tariff rates of the manufacturing industry of five major trading countries and weighted average (WAV) import tariff of 22 countries imposed on Thailand. In general, import tariff of trading partner countries with Thailand have been significantly lowered as a result of trade negotiations and trade integrations. The trend of the weighted average import tariff rate of 22 trading partner

countries slightly decreases over time. The weighted average import tariffs of China have dramatically fallen from nearly 20% in 1999 to about 2% in 2010; as a result, the share of trade between Thailand and China to total trade moves from 5% in 1999 to 19% in 2010. This result also suggests that the manufacturing exports from Thailand to China dominate the largest proportion in 2009 and 2010. Chinese import tariffs imposed on Thailand was significantly reduced due to the ASEAN and China Free Trade Agreement (FTA) in 2002. This agreement implemented the Early Harvest Program in 2003, which meant China had to reduce import tariffs on Thailand for product code 01-08 (foods and vegetables) under the Harmonize System to 0% in 2003. In addition, 60% and 90% of import tariffs of other products had to be reduced to 0% by 2007 and 2008, respectively. The trend of weighted average import tariffs of Japan, the second largest trade partner with Thailand, also significantly decreased due to the implementation of ASEAN and Japan FTA in 2008.

It is noteworthy that the manufacturing imports of Thailand are not affected by the import tariffs, since FDI has a number of benefits from investment promotion policies. The Thailand Board of Investment (BOI) provides incentives to FDI under the Investment Promotion Act of 1987, especially import duties as follow: exemption and reduction of import duties for machinery (sections 28 and 29); reduction of import duties on raw or essential materials (section 30); exemption for all raw and essential materials for use in production for export (section 36). According to the data of Thailand BOI, almost all FDI is registered with BOI, thus foreign firms can utilize the import duty exemption. According to the statistics of the Customs Department of Thailand, the exemption of import duty under the investment promotion, duty drawback under 19bis of the Custom Act, and other categories (free trade agreement, custom free zone, and export processing zone) share around 50%, 20% and 10% of total import, respectively.

The real bilateral exchange rate and real effective exchange rate have negative impacts on the export from Thailand to source countries and to other countries. This result is consistent with Athukorala and Suphachalasai (2004) and Jongwanich (2010). They found a positive impact of the real effective exchange rate on the export of the manufacturing industry, but the real effective exchange rate in both studies is estimated in terms of Thai Baht per foreign currency. However, the real exchange rate has no impact on the manufacturing imports of Thailand. It is noteworthy that the coefficients of dummy variables are positively significant in Table 5.1 and 5.3 and suggest that the post crisis manufacturing export is relatively higher than pre crisis manufacturing export. Although the global financial crisis started in July 2007, the actual impact on the manufacturing exports was only in 2009.

Figure 5.2 Manufacturing export from Thailand to five major trading partner countries



During 2007-2008, the crisis impacted mainly the financial market and stock market of Thailand. In the late 2008, the impact of the global financial crisis hit the real sector of Thailand. The USA and EU were in recession; the reduction of asset prices imposed constraints on investment; unemployment rose. As a result, it touched upon the external sector of their economies. The USA and EU dramatically reduced imports, which affected the exports and growth of export oriented economies, including Thailand, clearly evident since late 2008. However, the manufacturing exports of Thailand in 2010 rebounded to even higher levels than pre crisis due to stimulus packages in the USA, Japan, and many EU countries.

The main focus of this paper is how FDI impacts on the manufacturing exports of Thailand and the test of complementarity and substitution between FDI and the manufacturing imports of Thailand. The study found that the relationship of FDI and the manufacturing exports from Thailand to source countries is positive, but it is statistically insignificant. FDI flow to Thailand did not increase its manufacturing exports to the invested countries. This may be because most of the motivations of FDI to Thailand are market seeking or building exporting platform. Using the automotive industry as an example, the domestic sales of vehicles are 70% of total productions while 30% are for export. The domestic sale of pick-up trucks in Thailand is the second largest in the world. Although 70% of FDI in automotive industry are from Japan, the export of vehicles and auto parts from Thailand to Japan occupies only 4.3% in 2011. On the other hand, in the same year the export's share of vehicle and auto parts from Thailand to Australia, Indonesia, and Malaysia are 21.9%, 11.9%, and 5.4%, respectively (Thailand Board of Investment, n.d.). The a survey of 400 Japanese manufacturing firms by Dilios and Keeley (2001) also supported that most Japanese FDI in Thailand is market seeking because Thailand has large market potential in manufacturing industry.

FDI has a positive impact on the manufacturing exports from Thailand to other countries which indicates that FDI is invested in Thailand in order to utilize the factors of production. In other words, Thailand is an export platform for foreign firms. The same products in their home countries are not competitive and therefore they need to diversify the location of production. This result is quite reasonable since there are many sub-group industries under the manufacturing industry in Thailand which have strong comparative advantage.

The evidence is supported by FDI from Japan, since it has dominated FDI in Thailand from the late 1980s to the present. During 1999-2010, FDI from Japan covers about 40-60% of total investment each year in the manufacturing sector (see Table B.7 in Appendix B). Dilios and Keeley (2001) conducted a survey of 400 Japanese manufacturing firms in Thailand in 1999. They found the primary attraction of Japanese firms to invest in Thailand was the low-cost of labor especially local blue-collar employees. However, during the early 2000s, FDI from Japan concentrated more on capital-intensive manufacturing industries such as chemical and chemical products (24), radio, television and communication equipments (32) and motor vehicle, trailers and semi-trailers (34) under ISIC classification. These product groups have strong comparative advantage and their share of export to total export is around 30% of total export while FDI of these product groups shares about 40% of total FDI during 1999-2005 (see Table B.8 in Appendix B).

Although FDI has impacts on the manufacturing exports from Thailand to other countries, the elasticity is small. This is quite natural since FDI has a slower impact on the export than other variables. FDI is usually for establishing physical capital such as building structures and machinery and equipments and these factors are only a part of the production process (fixed asset). As a result, the impacts of FDI on export go through the process of producing output and enhancing export of the host country. Previous studies also found a small impact of FDI on exports in many countries. Jongwanich (2010) found that the coefficients of FDI on the manufacturing exports of China, Indonesia, Korea, Malaysia, and Thailand are 0.03, 0.02, 0.01, 0.01 and 0.04 respectively. Xuan and Xing (2010) found that the elasticity of FDI on the export of Vietnam is 0.23. Pain and Wakelin (1998) found that short run and long run elasticity of FDI on export are 0.01 and 0.06, respectively.

The results in Table 5.3 indicate that FDI complements manufacturing export from the source country to Thailand. In other words, FDI increase the manufacturing imports of Thailand. The foreign investors not only invest but also bring some machinery which is not produced in Thailand from their home countries to Thailand. Some parts and components, and raw materials are required to be imported since these products cannot be produced in Thailand. The statistics of the Customs Department of Thailand also report that about 50% of the manufacturing imports are raw materials and intermediate goods while only 20% of the manufacturing imports are capital goods and most of them are used in the export processing zones and industrial zones.

From the results of this chapter, it can be concluded that FDI has significant impacts on both the manufacturing exports from Thailand to other countries and the manufacturing imports into Thailand. As the exporting platform, foreign firms have an advantage to distribute their products to other ASEAN member countries because they can utilize FTA to export and import raw materials. In addition, trade costs inside ASEAN are relatively lower compared to trade costs from source countries to ASEAN countries due to the closer distance. For example, trade costs of the manufacturing exports from Japan to Malaysia are higher than trade costs of the manufacturing exports from Thailand to Malaysia. Therefore, trade costs are one of many factors attracting FDI from many countries into Thailand. On the other hand, FDI also affect trade costs through infrastructure, trade facilitation and trade barriers. Therefore, the study of relationship between FDI and trade costs is important[4]. As one component of trade costs, trade facilitation also plays a significant role in the decisions of foreign firms to invest in Thailand. If the procedure of exporting and importing is complicated, then the flow of export and import will be distorted. In the business world, a one day delay of export brings massive loss to the exporter, as well as, the importer. Trade costs and the impacts of trade facilitation are investigated in details the next chapter.

[4] The relationship of FDI and trade costs is discussed in Appendix D

CHAPTER VI: RESULTS OF TRADE COSTS AND IMPACTS OF TRADE FACILITATION ON THE MANUFACTURING EXPORTS OF THAILAND

This chapter includes three sections where the results and discussions are included in each section. Section 6.1 presents the descriptive results of the comprehensive trade costs of the manufacturing industry in Thailand. The manufacturing trade costs are compared across countries and their trends are illustrated. Section 6.2 shows the result of the decomposition of trade costs into tariff costs and non-tariff costs. Then, the contribution of components of trade costs is investigated. Section 6.3 analyzes the impacts of trade facilitation on the manufacturing exports of Thailand.

6.1 Descriptive Results of Trade Costs

The summary of the descriptive statistics of the two data sets is shown in Table 6.1. t_{ij}_wb is the manufacturing trade cost calculated by Arvis et al. (2012) which is available on the website of the World Bank, and t_{ij} is the manufacturing trade costs estimated by the author, using a different data set. The two gaps in the trade costs at the minimum point and maximum point are about 8 and 0.1, respectively. The equality tests, i.e., mean test and variance test, were applied for two data sets. The null hypothesis of the mean test is that the means of two variables are equal. According to the results in Table 6.1, t-test (-1.086) is lower than t-statistics (1.96) so the null hypothesis indicating that the mean of the two data sets is not significantly different cannot be rejected. The null hypothesis of the variance test is that the ratio of variance of the two data sets is equal to one. The result shows that the F-test is lower than the F-statistics and hence the null hypothesis cannot be rejected. In addition, the correlation between the data set of this study and the data set of Arvis et al. (2012) is relatively high. It can therefore be concluded that trade costs in this paper are not different from the trade costs calculated by Arvis et al. (2012).

Table 6.1 Summary of statistics of trade costs and statistical tests

Variable	Obs.	Mean	Std. dev.	Min.	Max.
t_{ij}_wb	263	98.362	28.191	27.028	160.760
t_{ij}	263	101.064	28.844	35.764	160.636
Mean test	H_0: Mean difference = 0			t = -1.086	
	H_1: H_0 is not true				
Variance test	H_0: Ratio of two variances = 1			F = 0.952	
	H_1: H_0 is not true				
Correlation	0.812				

The manufacturing comprehensive trade costs are defined as ad valorem equivalent. For example, the ad valorem equivalent comprehensive trade costs of manufactured goods between Thailand and Australia in 1999 was 110.04%, which means that on average the cost of manufacturing trade between Thailand and Australia was 110.04% of the value of the manufactured goods (see Table C.1 in Appendix C). The comprehensive trade costs of the manufacturing industry between Thailand and Australia is an average of the trade costs from Thailand to Australia and trade costs from Australia to Thailand. The manufacturing trade costs of Thailand and Singapore are the lowest, as the import tariff that the manufacturing industry of Singapore imposes on Thailand is zero per cent and because the two countries are close to each other. The manufacturing trade costs of Thailand and Malaysia are also low due to the two countries sharing the same border.

The manufacturing trade costs are relatively high between Thailand and the EU members. For example, the manufacturing trade costs of Thailand and Denmark, Italy, Spain and Sweden in 1999 were 146%, 143%, 160% and 144% of the value of the manufactured goods, respectively. It is noteworthy that those countries' shares are a small proportion of the manufacturing trade with Thailand. The additional results of comprehensive trade costs with the different assumptions of elasticity of substitution across the manufacturing industry are presented in Table C.2 and C.3 in Appendix C.

It is remarkable that the choice of the elasticity of substitution across the manufacturing industry is sensitive to the absolute value of the comprehensive trade costs. For example, the comprehensive trade cost of the manufacturing industry of Thailand and Australia is reduced to 68% of the value of the manufacturing goods when the elasticity of substitution changes to eleven and it increases to 266% when the elasticity of substitution changes to five. The reason is that when the elasticity of substitution is high, the consumption of one product is greatly substituted for other products and therefore the trade of such a product is not required.

Although trade cost has the shortcoming of using solely international trade and intra-national trade data, the results obviously imply the actual trade cost to Thailand and its trading partners when compared across countries and over time. In general, the manufacturing trade costs between Thailand and its trading partners fall over time. This result is consistent with trade costs of many countries around the world. Duval and Utoktham (2012) pointed out that trade costs had been decreased due to the improvement of both tariff and non-tariff costs.

Figures 6.1 and 6.2 show the comprehensive trade costs of the manufacturing industry between Thailand and five major trading partners and the weighted average of trade costs of 24 countries. The most important trading partner, Japan, has relatively lower manufacturing trade costs compared with those from of other countries. The manufacturing trade costs of Thailand and ASEAN countries are almost at the same level as the manufacturing trade cost between Thailand and Japan, signifying that ASEAN trade integration has improved trade costs in the region. Interestingly, the gap in trade costs between Thailand and Japan and between Thailand and China has become smaller due to the improvement of trade between Thailand and China as a consequence of the ASEAN-

China FTA. However, the manufacturing trade costs between Thailand and the EU are relative high.

Figure 6.1 Manufacturing trade costs of Thailand with major trading partner countries

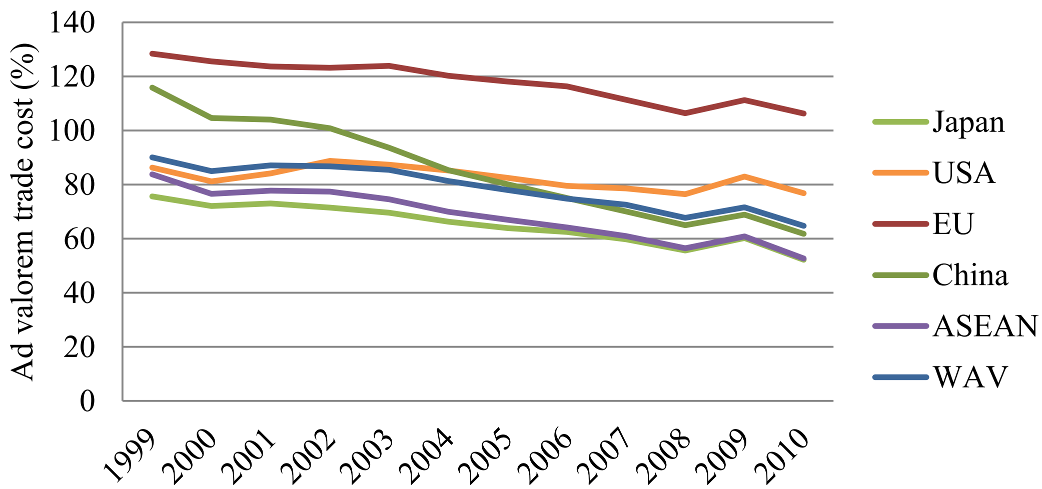
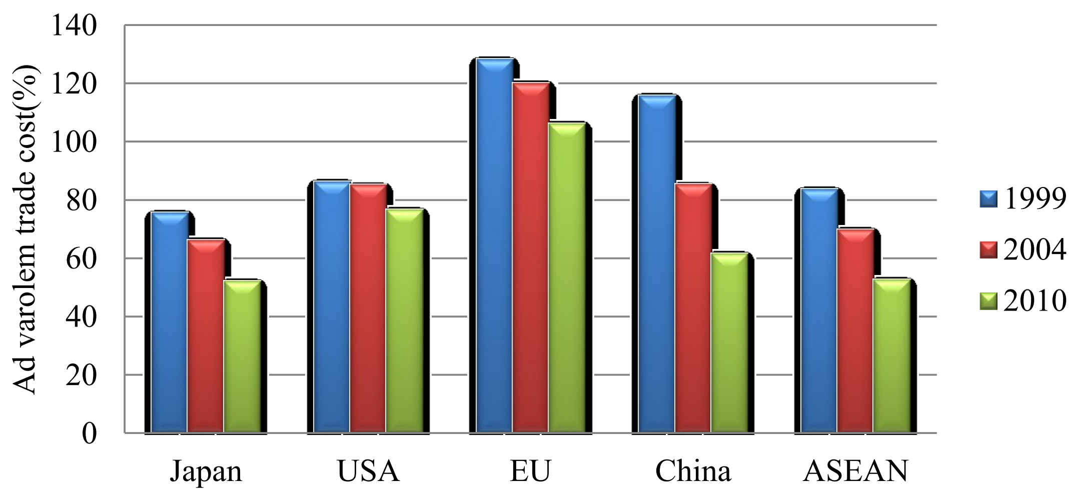


Figure 6.2 Comparison of the manufacturing trade costs of Thailand with five major trading partner countries

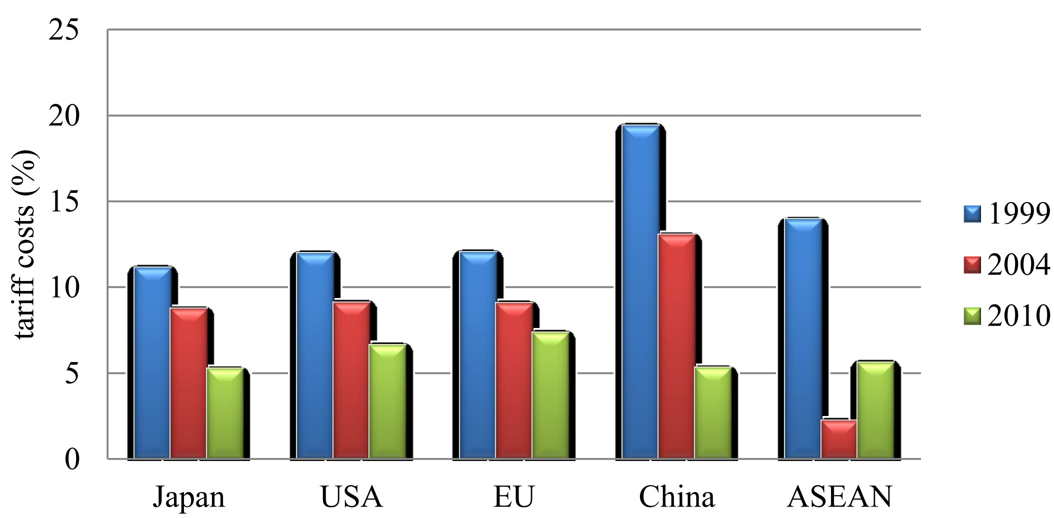


6.2 Decomposition of Trade Costs

The manufacturing trade costs of Thailand have shown a dramatic decrease during the 2000s due to the reduction of both tariff and non-tariff costs. Figure 6.3 shows the geometric average import tariff of Thailand's manufacturing industry and five major trading partners. In general, the manufacturing tariff costs have decreased over time. Tariff costs of Thailand and its trading partners have fallen because of ASEAN's FTAs with Japan, China and the Republic of Korea. In addition, Thailand has also signed bilateral FTAs with Japan, Australia and India and more FTAs are in the process of negotiation. Interestingly, the manufacturing tariff costs between Thailand and China significantly decreased from almost 20% in 1999 to 5% in 2010 following the implementation of the ASEAN-China FTA in 2002.

It is noteworthy that the average tariff costs between Thailand and other ASEAN members in 2010 were higher than in 2004. The geometric average tariff cost is calculated by using the weighted average of the tariff that country *i* imposes on country *j,* and country *j* imposes on country *i*.

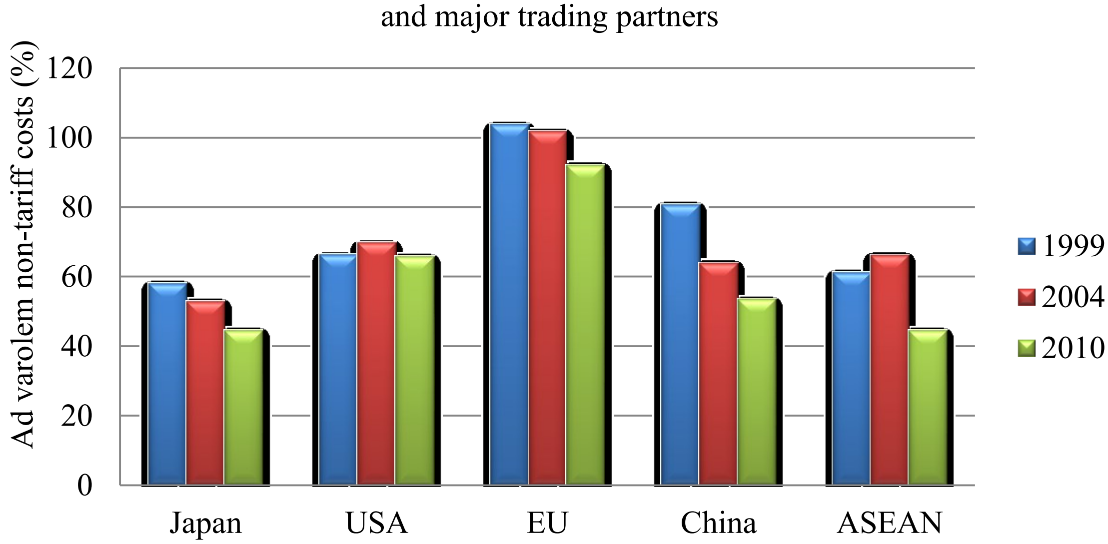
Figure 6.3 Tariff costs of the manufacturing industry of Thailand and major trading partners



It was found that in 2010 the imports by Thailand from Indonesia and from the Philippines were weighted much more on trade of manufactured vehicles, bodies, parts and accessories for vehicles (34) where the shares of imports of these products were 13.97% and 23.27% of total import by the manufacturing industry, respectively. The average import tariff of products (34) that Thailand imposes on Indonesia is 24.85% while that imposed on the Philippines is 39.24%. As a result, the weighted average tariff between Thailand and other ASEAN members in 2010 was higher than in 2004.

As mentioned in the methodology section above, non-tariff costs are all additional costs other than tariff costs i.e., transportation costs, trade facilitation costs, and the costs of preparing trade documentation, customs clearance, goods transport and handling at the port. Figure 6.4 shows the non-tariff costs of Thailand's manufacturing industry with its major trading partners. In general, the non-tariff costs decrease over time. The improvement of infrastructure, including road, seaport, airport and trade facilities, is the main factor responsible for the reduction of non-tariff costs.

Figure 6.4 Non-tariff costs of the manufacturing industry of Thailand and major trading partners



The non-tariff costs of the manufacturing industry between Thailand and Japan are relatively lower than in other countries. It is expected that the non-tariff costs of the manufacturing industry of Thailand and other ASEAN members will be lower than those of Thailand and Japan, since Indonesia, Malaysia and the Philippines are closer to Thailand. The transportation costs between Thailand and other ASEAN members should be lower than with other countries. However, trade facilitation indicators in ASEAN countries (except Singapore) are more complicated than those in Japan. For example, the time for exports by Indonesia, Malaysia and the Philippines are 17, 13 and 15 days, respectively, while the time for exports by Japan is 10 days. In addition, the logistics performance and quality of port infrastructure of ASEAN countries (except Singapore) are far behind those of Japan (see Table 6.2 and 6.3). Non-tariff costs of Thailand and EU countries are weighted much more on transportation costs although the performances of trade facilitation in EU are relative better than those in ASEAN countries.

Table 6.2 Statistics of trade facilitation and logistics performance of ASEAN countries

Trade facilitation factors	Thailand		Indonesia		Malaysia		Philippines		Singapore	
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Export documents (number)	24	14	4	4	5	5	7	7	4	4
Time for exports (days)	10	10	22	17	13	13	17	15	5	5
Cost of exports (US$)	848	625	486	644	432	450	755	630	415	456
Import documents (number)	12	5	7	7	6	6	8	8	4	4
Time for imports (days)	22	13	27	27	10	10	18	14	4	4
Cost of imports (US$)	1042	795	430	545	385	450	800	730	367	439
Logistics performance index (1=low to 5=high)	-	3.29	-	2.76	-	3.44	-	3.14	-	4.09
Quality of port infrastructure (1= extremely underdeveloped to 7 = well developed)	-	5.03	-	3.62	-	5.57	-	2.76	-	6.76

Source: World Bank, 2013

Table 6.3 Statistics of trade facilitation and logistics performance of Thailand's major trading partners

Trade facilitation factors	Japan		USA		China		Germany		France	
	2005	2010	2006	2010	2005	2010	2005	2010	2005	2010
Export documents (number)	3	3	4	4	8	8	4	4	7	2
Time for exports (days)	10	10	6	6	23	21	7	7	18	9
Cost of exports (US$)	859	880	960	1050	390	500	740	872	1028	1072
Import documents (number)	5	5	5	5	6	5	5	5	13	2
Time for imports (days)	11	11	5	5	26	24	7	7	20	11
Cost of imports (US$)	957	970	1160	1315	430	545	765	937	1148	1248
Logistics performance index (1=low to 5=high)	-	3.97	-	3.86	-	3.49	-	4.11	-	3.84
Quality of port infrastructure (1= extremely underdeveloped to 7 = well developed)	-	5.15	-	5.53	-	4.32	-	6.38	-	5.87

Source: World Bank, 2013

The second approach used the pooled least square regression of equation (3.40). Equation (3.40) is regressed twice by changing the geometric average number of documents in the export and import procedures by the geometric average of time in the export and import procedures. The reason is that the number of documents used in the process of export and import has an impact on the time for export and import. In other words, the correlation between number of documents and time for trade is 0.776 which is moderately high. The results of decomposition of trade costs are presented in Table 6.4.

In general, two regressions provide identical coefficients in terms of the sign, but they are slightly different in terms of degree of impact. The coefficients of variables in Table 6.4 are interpreted as the elasticity of trade cost. For example, the coefficient of distance is 0.31, indicating that a 1% increase in the distance between Thailand and its trading partners results in the manufacturing trade costs between Thailand and its trading partners increasing by 0.31%. The average tariff rate of the manufacturing industry increases the trade cost since the tariff rate is directly added to the price of the manufactured goods. The coefficient of the exchange rate is statistically insignificant. The reason is that the exchange rates of Thailand and its major trading partners, such as Japan, EU and China, were stable during 2005-2010. Therefore, the exchange rate cost is relative low. Consequently, there is no impact by the exchange rate on the manufacturing trade cost of Thailand.

Table 6.4 Decomposition of the manufacturing trade costs

Variables	Coefficient	Beta	Coefficient	Beta
$lndist_{ij}$	0.310***	0.703	0.321***	0.730
	(0.023)		(0.054)	
$lntariff_{ij}$	4.797***	0.285	4.274***	0.254
	(0.787)		(1.451)	
$lnexch_{ij}$	-0.000	-0.005	0.002	0.014
	(0.012)		(0.110)	
$lnconec_{ij}$	-0.199***	-0.254	-0.158***	-0.201
	(0.041)		(0.033)	
$lndoc_{ij}$	0.221***	0.157		
	(0.073)			
$lntime_{ij}$			0.319***	0.243
			(0.127)	
constant	-1.709***			
	(0.319)			
	N = 138		N = 138	
	R^2 = 0.779		R^2 = 0.802	

Note: Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01

The coefficient of the liner shipping connectivity index shows a negative impact on trade costs, signifying that trade costs between Thailand and its trading partners are lower if they have a higher liner shipping connectivity index. The reason is that if a country has more shipment connections to other countries, it tends to manage transportation routes more efficiently than those having less shipment connections; therefore, that country can reduce time costs and other costs. The coefficients of trade facilitation factors such as time and documents required for the export and import processes are positively significant. The cost of import and export documents is incurred by the exporter and importer having to get the necessary documentation from the relevant agencies. The main documents include an export permit, cargo movement permit, cargo insurance, customs declaration, among others. Some countries provide these documents in one place, i.e., a "one stop service", while in many countries these documents have to be acquired from different offices. The greater the number of documents involved in the export and import processes, the higher the trade costs, not only in terms of money (fees, service change and taxes), but also in terms of opportunity cost (waiting time).

The time requirement in the export and import processes also has a positive impact on trade cost. Time requirements for exports and imports here include time spent in getting documents and permission, customs clearance and inspection at the border checkpoint at seaports and airports. The time requirement for exports and imports add to trade costs if there is any uncertainty (exchange rate, insurances and accidents) during transportation from factory to destination. For the manufacture of processed foods, which are sensitive to time, the cost of damage and spoilage should be taken into account.

It is important to compare the contribution of the components of trade cost to total trade cost. The standardized coefficients (beta)[5] are calculated. Standardization of the

---

[5] Standardized coefficients are calculated as follow: $\hat{\beta}_j^* = \frac{\widehat{\beta_j} S_{x_j}}{S_Y}$, where $\widehat{\beta_j}$ is the coefficient from regression, S_{x_j} and S_Y are standard deviations of independent variables (x_j) and dependent variable (Y), respectively.

coefficient is usually done in order to answer the question of what level the effect of each variables is on the dependent variables in a multiple regression analysis, where beta is simply dividing coefficient by the ratio of standard deviation of corresponding variables. According to Table 6.4, a one standard deviation increase in bilateral distance is associated with about a 0.703 standard deviation increase in the manufacturing trade costs. Distance makes the strongest contribution to the manufacturing trade cost compared to other variables. This result rejects the "death of distance[6]" hypothesis in trade costs (Disdier and Head, 2008).

The average tariffs contribute more to trade costs than average documents required in the export and import procedure. However, when the time for export and import replaces the number of documents required for export and import, the contribution of the time required in the procedures to trade costs is almost the same as the contribution of tariffs to trade costs, indicating that trade facilitation has become more important in recent international trade. The other reason is that most of the tariffs in the manufacturing industry of Thailand and its trading partners are already at a low level since 2005 (see Figure 6.3). The liner shipping connectivity index makes a significant contribution to trade costs.

6.3 Impacts of Trade Facilitation on the Manufacturing Exports of Thailand

The impacts of trade facilitation on the manufacturing exports are investigated by using an augmented gravity model. According to results from chapter V, FDI has no impacts on the manufacturing exports from Thailand to source countries of FDI. In addition, if FDI is included in the equation (3.42), many observations are dropped. As a result regression provides inconsistency results. For these reasons, FDI is excluded from the equation (3.42). The summary of variable statistics is presented in Table C.4 in

---

[6] The death of distance hypothesis suggest that distance is not the main component of trade cost

Appendix C. The Pooled Least Squares (LS), the Fixed Effects model (FE), and the Random Effects model (RE) are proposed here since the data are panel. In order to select the FE model or the RE model, the Hausman test is applied where the null hypothesis is that the individual specific error component correlate with explanatory variables. In other words, the null hypothesis is preferred over the RE model. The result suggests that the null hypothesis cannot be rejected (see Table C.6 in Appendix C). Therefore, the RE model is preferred. Furthermore, it is necessary to decide whether the random effect is valid in the data or not. The Breusch-Pagan Lagrange Multiplier (LM) test is applied in order to decide between the RE model or the pooled LS. The null hypothesis of the Breusch-Pagan LM test is that variance across entities is zero. That is, there is no significant difference across units (countries).

According to the result of the Breusch-Pagan LM test, the null hypothesis is rejected and it is concluded that there is a significant difference across the countries (see Table C. 7 in Appendix C). The endogenous problem may arise in the RE model because the assumption of the RE model is that individual specific errors are correlated with the same independent variables. If this is the case, the RE model is inconsistent. The Hausman-Taylor estimator is an instrumental variable estimator used to solve the problem of inconsistency in the RE model. Here $lnY_{j,t}$ is assumed to correlate with the random effects. The fixed effect transformation of $\widetilde{lnY_{j,t}} = lnY_{j,t} - \overline{lnY_{j,t}}$ eliminates the correlation with the random effects ($\overline{lnY_{j,t}}$ is an average across time). Therefore, $\widetilde{lnY_{j,t}}$ is the suitable instrument for $lnY_{j,t}$. Heteroskedasticity and serial correlation are controlled by using robust standard error.

Table 6.5 shows the results of the regressions using Pooled LS, the FE model, the RE and the Hausman-Taylor model. The discussion of coefficients is based on the results of the Hausman-Taylor model. In general, signs of the coefficients are consistent with the theory of the gravity model and previous studies. The coefficients are slightly different among the four models. The coefficients are interpreted as the elasticity of the manufacturing exports. For example, the coefficient $lnY_{j,t}$ is 0.927, which means a 1% increase in the manufacturing output of country j increases the manufacturing exports by Thailand by 0.927%. Distance is one important factor in trade cost and the manufacturing exports by Thailand. If country j is further away from Thailand by 1%, the manufacturing exports by Thailand to country j decrease by 1.331%.

Table 6.5 Regression results

Variables	Pooled LS	FE	RE	Hausman-Taylor
$lnY_{i,t}$	1.062***	1.106***	0.857***	0.927***
	(0.405)	(0.117)	(0.121)	(0.129)
$lnY_{j,t}$	0.489***	0.399**	0.511***	0.508***
	(0.055)	(0.160)	(0.131)	(0.113)
$lndist_{ij}$	-1.080***		-1.234***	-1.331***
	(0.084)		(0.143)	(0.364)
$lnexch_{ij,t}$	0.134***	0.498**	0.156***	0.195**
	(0.023)	(0.177)	(0.040)	(0.096)
$lnt_{ji,t}$	-6.083***	-0.909	-1.306	-1.099
	(1.674)	(1.321)	(1.439)	(1.111)
$lndoc_{ij,t}$	0.418	-0.211**	-0.194**	-0.200*
	(0.345)	(0.094)	(0.087)	(0.108)
$lnconec_{ij,t}$	0.700***	-0.192	0.266	0.034
	(0.063)	(0.213)	(0.211)	(0.226)
crisis	0.004	-0.032	-0.041	-0.034
	(0.145)	(0.032)	(0.035)	(0.032)
constant	-6.037**	-10.773***	-0.504	1.284
	(5.710)	(1.911)	(1.822)	(3.270)
N	138	138	138	138
R^2	0.751	0.822	0.813	

Note: Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01

The coefficient of the exchange rate is positively significant at the 1% level, indicating that a 1% increase in the exchange rate will increase the manufacturing exports by 0.195%. In other words, if the value of the Thai Baht appreciates by 1%, the manufacturing exports by Thailand increase by 0.195%. It is noteworthy that tariffs that country *j* impose on the manufacturing imports from Thailand are negative but not statistically significant. Recalling the results reported in section 5.1 in the previous chapter, the tariff rate is important to the manufacturing exports of Thailand during 1999-2010. However, the tariff rate of the manufacturing industry was stable at a low level after 2005, except in the case of China where tariffs decreased slightly.

The main focus of this section is to show how trade facilitation affects the manufacturing exports by Thailand. The average number of documents in the export and import procedures is negatively significant at the 10% level, indicating that a 1% increase in the number of documents decreases the manufacturing exports by 0.2%. The documents in the process of export and import require approval from the related offices. For example, the customs declaration form requires approval from the customs office while a letter of credit needs to be prepared and approved by a bank. Transportation from one office to another office incurs both direct costs (fees, service charge, and transportation cost) and indirect cost (opportunity cost). If many documents are involved in the process, the flow of exports and imports is distorted. A lengthy and complicated process is therefore an obstacle to exporters and importers as well as to investors who plan to invest in exporting from Thailand.

In Thailand, the number of documents required in the export process is relatively higher than that in its trading partners (see Table 6.2). They are even greater in number than in certain other comparable ASEAN members such as Malaysia. Keretho and Naklada (2011) shows exporting auto spare parts from Thailand to India required 29 documents, including more than 800 data elements, while the import process in Thailand for electronic devices from China required 24 documents, including 700 data elements. Twelve parties are involved in the process of exporting auto spare parts. OECD (2003) indicated that direct and indirect costs from export and import procedures cover between 1% and 15% of product costs. This cost equals tariff cost in many developed countries.

Table 6.6 Regression results

Variables	Pooled LS	FE	RE	Hausman-Taylor
$lnY_{i,t}$	0.353	0.863***	0.615***	0.674***
	(0.380)	(0.118)	(0.102)	(0.146)
$lnY_{j,t}$	0.530***	0.455**	0.548***	0.550***
	(0.055)	(0.124)	(0.109)	(0.109)
$lndist_{ij}$	-1.151***		-1.269***	-1.338***
	(0.088)		(0.158)	(0.328)
$lnexch_{ij,t}$	0.112***	0.444**	0.150***	0.177**
	(0.020)	(0.186)	(0.041)	(0.087)
$lnt_{ji,t}$	-4.385***	-0.607	-0.931	-0.776
	(1.730)	(1.200)	(1.285)	(1.079)
$lntime_{ij,t}$	0.589**	-0.426***	-0.462***	-0.449***
	(0.260)	(0.072)	(0.061)	(0.125)
$lnconec_{ij,t}$	0.641***	-0.117	0.273	0.109
	(0.062)	(0.214)	(0.210)	(0.215)
crisis	0.048	-0.028	-0.039	-0.032
	(0.138)	(0.025)	(0.030)	(0.031)
constant	-6.190	-7.722***	-4.407**	4.722
	(5.254)	(1.527)	(1.992)	(3.177)
N	138	138	138	138
R^2	0.756	0.833	0.826	

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 6.6 presents the results of alternative variables since time involved in exporting and importing reflects the number of documents required for the export and import processes. In other words, times for export and import are highly correlated with number of documents in the export and import processes. In general, the results are consistent with the previous one. The coefficient of time for exports and imports is negatively significant at the 1% level, indicating that a 1% decrease in the time taken by the export and import processes increases the manufacturing exports by 0.445%. In other words, each day of delay in the export and import procedure decreases the manufacturing exports by Thailand.

The export and import times are still the main barrier facing exporters and importers in Thailand. Keretho and Naklada (2011) showed that the time required for exporting auto spare parts from Thailand to India was 51 days while the time for importing electronic devices from China was 5 days. A survey by Cheewatrakoolpong and Ariyasajjakorn (2012) of trade costs of 500 firms in Thailand found that the average export procedure of manufacturing products was 9.16 days. They found that the composition of time associated with trade facilitation for manufacturing products included 3.75 days for standard and conformity assessment; 2.29 days for in-land transportation; 2.38 days for customs procedures; and 0.72 day for port handling. The average export procedure accounted for 8.29% of the value of the manufacturing exports by Thailand.

Since trade facilitation is an important factor in exports and imports by Thailand, the Government implemented a Logistic Master Plan, 2011. The purpose of the plan is to reduce the logistic cost, and one objective is to enhance trade facilitation by implementing a single window service. This project intends to reduce redundant information as well as the number of documents and time involved in export and import procedures. In addition, the government of Thailand also jointed Great Mekong Sub-region (GMS) Program where the goal of this project is to boost trade of Mekong Sub-region countries through the improvement of infrastructure and trade facilitation. The GMS Program initially developed three economic corridors namely the Southern Economic Corridor (connecting Cambodia–Viet Nam with Thailand), the East–West Economic Corridor (connecting Lao PDR–Viet Nam with Thailand), and the Northern Economic Corridor (connecting Yunnan with Lao PDR and Thailand) where most of them have been completed. To support transport and trade facilitation, Cross Border Trade Agreement (CBTA) was implemented. This agreement covers various aspects such as custom inspection, person movement, transit traffic, and road and bridge design standard.

The improvement of trade facilitation in recent years reduces export cost and import cost of Thailand. World Bank (2013) also shows that cross-border trade indicators for Thailand have made significant progress. The export cost for Thailand was reduced from 848 US$ per 20-foot container in 2005 to 625 US$ per 20-foot container in 2010 while the import cost for Thailand has been decreased from 1,042 US$ per 20-foot container in 2005 to 750 US$ per 20-foot container in 2010. The time taken in the export and import processes was also reduced from 24 and 22 days, respectively, in 2005 to 14 and 13 days, respectively, in 2010. This is one of the reasons why the manufacturing exports by Thailand flourished in the late 2000s.

CHAPTER VII: CONCLUSIONS AND POLICY IMPLICATONS

7.1 Conclusions

Based upon the results reached in Chapters IV, V and VI, there are a number of conclusions that can be drawn. In Chapter IV, the study analyzed the export performance of the manufacturing industry during 1990 to 2010 and identified the factors influencing trade performance. It found that many groups of industries performed well in the world market. The comparison of six RCA indices suggests that SRCA had the highest correlation between the value of index and its ranks across industries and over time. The results of the comparative advantage, the multi-factors model and logit regression suggest that the manufacturing industry exported labor-intensive goods in the early 1990s and it was in a transition to export capital-intensive goods in the 2000s. Thus, the results of Chapter IV show that the manufacturing industry in Thailand is shifting from exporting labor-intensive goods to exporting capital-intensive goods.

The results of Chapter IV lead to the question of factors that have influenced the transition process. This question was explored in Chapter V. Foreign direct investment is one factor that has supported the export of the manufacturing industry in Thailand for many decades. For this reason, the roles of FDI on export of the manufacturing industry in Thailand were discussed in this chapter. The impacts of FDI and other variables on the manufacturing exports in Thailand were investigated using the augmented gravity model. Main variables such as GDP of host and source countries and distance were found to be consistent with the results of previous studies in term of relationship with the exports. Tariffs have a strong impact on the manufacturing exports but not on the manufacturing imports in Thailand. The results established by the augmented gravity model used in Chapter V clearly show that FDI has an impact on the export from Thailand to other countries while there is no significant impact of FDI on the exports from Thailand to source countries. The results also indicate that FDI complements the manufacturing exports from the source country to Thailand. It supports the belief that foreign firms invest in Thailand to produce and subsequently export to other countries since many sub-groups under the manufacturing industry have comparative advantage.

Turning to the analysis of trade costs in Chapter VI, the results suggest that manufacturing trade costs have continuously decreased over time due to the reduction of tariff and non-tariff costs. The manufacturing trade costs between Thailand and Singapore were found to be the lowest while trade costs between Thailand and Japan, the most important trading partner of Thailand, are the third lowest. On the other hand, the manufacturing trade costs between Thailand and the EU turned out to be relatively high due to distance. Next, manufacturing trade costs were broken down into their components. Distance contributed the most to trade costs. Trade facilitation such as number of documents and time involved in exporting and importing, has also been an important factor associated with trade costs in recent years. This study draws the conclusion that trade facilitation has greatly impacted on the manufacturing exports by Thailand and has become as important a component in the manufacturing trade of Thailand as tariffs. The results of this study are robust and exhibit consistency with previous studies that have found that improvement in trade facilitation enhances the manufacturing exports by Thailand.

7.2 Policy Implications

From Chapters IV and V, a number of policy implications can be drawn. First, the industry groups which have comparative disadvantage, especially labor-intensive goods, should consider diversifying their investment to locations with lower labor costs. For example, labor-intensive firms can move their location to the cities that close to neighboring countries such as Cambodia, Laos, and Myanmar. They can import labors from neighboring countries to work for their firms. The CBTA of Mekong Sub-region also enhances the cooperation of trade and investment between border twin cities. This program supports the movement of labor and stimulates the investment of three main twin border cities of Thailand and neighboring countries. Those are Nakhon Phanom (Thailand) and Tha Khaek (Lao PDR), Maesort (Thailand) and Myewaddy (Myanmar), and Mukdahan (Thailand) and Savannakhet (Lao PDR).

Second, the manufacturing industry in Thailand should restructure the labor intensive industries which mean manufacturing firms need to shift the production process to the one which creates more value added. This transition requires an innovation including technology, management and market. For the example, garment industries can shift from CMT (Cut, Make, and Trim) and FOB (Free on Board) process to the one with own design, brand and market. The government also has to support R&D by implementing various policies. For example, the R&D's expenditure of firms can be deducted 200% from revenue in balance sheet.

Third, capital-intensive goods require more investment in machinery and technology. In order to do that, the government of Thailand should promote domestic and foreign investment. Various policies can be implemented to stimulate such investment; for instance, relaxing the limitation of foreign shareholder, improving trade and investment facilitation, and developing infrastructure. In order to attract such investment, labor requires more training for skills improvement in line with enhancement of capital. The skills of labor should meet the requirement of firms which means the firms should coordinate with the training institute and government in order to match labor to appropriate work in the firms.

Finally, diversifying the export to many other trading partners is another policy that the Thai's government should consider since the export of the manufacturing industry in Thailand relies heavily on Japan and the United States. Trade negotiations and bilateral trade agreement should be considered as one way to diversify trading partners.

Based on the results of Chapter VI, some policy recommendations worth considering would be, first, to continue the negotiation of FTAs with important markets like the USA and EU in order to reduce trade barriers in these countries. Non-tariff costs such as logistics costs should be reduced by developing and improving infrastructure such as roads, seaports and airports. Second, the Government of Thailand should fully implement the National Single Window Service, CBTA and ASEAN Single Window Service at all border checkpoints. Although such policies are implemented, exporters and importers do not fully utilize the benefit of these policies due to the lack of understanding. The promotion and explanation of the Single Window Service to both exporters and importers is necessary in order to improve their understanding .Third, the operation of polices, custom officers, and related government agencies must be transparent in term of collecting fees and operating time. For example, the fee must indicate clearly how much exporters and importers have to pay in the bills. The procedure of reclaiming Value Added Taxes (VAT), custom fee, and other expenses should be simple and less process in order to support the liquidity of exporter and importers. The policy to shorten export and import procedures, which involve excessive documents, authorizing agents and duplication will promote not only the export of Thailand but also FDI into Thailand.

7.3 Limitations and Suggestions for Further Study

The three chapters of analysis have not been linked in the empirical models. This limitation is due to the lack of data However, the linkage among the three chapters have been clearly established by logical connection and evidence supporting that connection. The evidence shows that the trade performance of the manufacturing industry of Thailand is influenced by FDI. Furthermore, the incentive factor for foreign firms to invest in Thailand- its reputation as a regional distributor in the ASEAN region - is influenced by trade costs. In Chapter IV, the study explains export performance and the factors influencing comparative advantage of manufacturing. The multi-factors model and logit regression use the factors intensity to explain the net export of the industry. However, this method has a limitation since supply alone does not fully determine the direction of trade. To offset that difficulty, the study combines many methods, trade performance, export-only RCA and trade-cum RCA to support the idea that Thailand is transforming from an exporter of labor-intensive goods to one of capital-intensive goods.

Although the analysis in Chapter V has provided evidence of the impact of FDI on the manufacturing exports by Thailand, there are some constraints and limitations of data. The data of FDI and export of the manufacturing industry covers 57 sub-industries. Differences in characteristics, factors endowment, and policies may provide differing motivations for FDI and therefore FDI may have diverse impacts on the export and import in each sub-industry. However, the data at the sub-industry level is not available in any statistics office. Thus, further investigation should concentrate on potential sub-industries of the manufacturing industry in Thailand, if sufficient data can be obtained.

The study of trade costs of the manufacturing industry in Chapter VI also has some limitations. Estimated trade costs require the elasticity of substitution across the manufacturing industry. It is assumed equal to a certain value over time and over countries which does not reflect the real situation. Therefore, a method to estimate elasticity of substitution over time and across countries to use for calculating trade costs needs to be developed. Another limitation is that the number of documents and time for export and import are calculated by using the average of documents and times used in the procedures for all products including agricultural products. It can be expected that the number of documents or time in the process of export and import may underestimate the actual value of these variables since the export or import of agricultural products is sensitive to health and sanitary issues. Thus, it requires more documents and inspection time. Trade facilitation components such as legal and institutional frameworks and trade finance are not included in our study since there are no appropriate indicators for the analysis., It would be interesting to investigate the impact of these factors on the manufacturing exports if data can be constructed in the future.

REFERENCES

Anderson, J. E. & van Wincoop, E. (2003). Gravity with gravitas: A border puzzle. *American Economic Review*, 33(1), 172-192.

___________________________. (2004). Trade costs. *Working Paper,* 10480, NEBR.

Akamatsu, K. (1962). A historical pattern of economic growth in developing counrty. *Journal of Developing Economies,* 1(1), 3-25.

Athukorala, P. & Suphachalasai, S. (2004). Post-crisis export performance in Thailand. *ASEAN Economic Bulletin*, 21(1), 19-36.

Appleyard, D. R., Field, JR A. J., & Cobb, S. L. (2010). *International Economics*. 7th ed. New York, USA: McGraw-Hill.

Arwatchanakarn, P., & Srisangnam, P (2009). ความได้เปรียบโดยเปรียบเทียบของสินค้าไทย และสินค้าอินโดเนเซียที่ส่งออกไปยังตลาดอาเซียน [Revealed comparative advantage: Thailand and Indonesia product exports in ASEAN countries]. Retrieved October 12, 2012, from http://www.eco.ru.ac.th/ eco/necon6/papers/g5/5.6.pdf

Arvis, J. F., Duval, Y., & Utoktham, C. (2012). Trade costs in developing world: 1995-2010. *Working Paper Series,* 121, Asia-Pacific Research and Training Network on Trade.

Baldwin, R. E. (1971). Determinants of the commodity structure of United States trade. *American Economic Review,* 6, 126-46.

Balassa, B. (1965). Trade liberalization and 'Revealed' comparative advantage. *Manchester School of Economic and Social Studies*, 33, 99-125.

Branson, W. H. & Monoyios, N. (1977). Factor input in United States trade. *Journal of International Economics,* 7, 111-131.

Bebek, U. gunes. (2012). Robustness of the proposed measures of revealed comparative advantage. *School of Economics Discussion Papers,* 1121, University of Kent.

Camarero, M. & Tamarit, C. (2003). Estimating exports and imports demand for manufactured goods: The role of FDI. Department of Economics, Jaume I University. Retrieved June 10, 2012, from http://www.uclm.es/profesorado/obajo/imagenes2/VIII%20Jornadas/pdf/51%20Camarero2.pdf

Chaisrisawatsuk, S., & Chaisrisawatsuk, W. (2007). Imports, export and foreign direct investment interactions and their effects. *Working Paper Series,* 45, Asia-Pacific Research and Training Network on Trade. Retrieved January 10, 2012, from http://www.unescap.org /tid/artnet/pub/wp4507.pdf

Cheewatrakoolpong, K., & Ariyasajjakorn, D. (2012). The quantitative assessment of trade facilitation on Thailand's exports. Institute of Trade and Development of Thailand. Retrieved June 1, 2012, from http://www.apeaweb.org/confer/sing12/papers/S12-173%20Ariyasajjakorn_Cheewatrakulpong.pdf

Chen, N. & Novy, D. (2009). International trade integration: A disaggregated approach. *CEP Discussion Paper,* 908, Center for Economic Performance, London School of Economic and Policy Science.

Dalum, B., Laursen, K. & Villumsen, G. (1998). Structural change in OECD export specialisation patterns: de-specialisation and 'stickiness'. *International Review of Applied Economics,* 12, 423-443.

De, P. (2006). Why trade cost is matter? *Working Paper Series*, 7, Asia-Pacific Research and Training Network on Trade. Retrieved June 1, 2012, from http://www.unescap.org/tid/artnet/pub/wp706.pdf

Dilios, A. & Keeley, T. D. (2001). Japanese foreign direct investment in Thailand: An empirical qualitative post-crisis analysis. *Journal of International Business and Economy,* 1(1), 91-118.

Disdier, A. C. & Head, K. (2008). The puzzling persistence of distance effect of bilateral trade. *Review of Economics and Statistics*, 90(1), 37-48.

Duval, Y. & Utoktham, C. (2011). Trade cost in the India - Mekong subregion: Identify policy priorities for trade facilitation. *Staff Working Paper*, 04, UNESCAP. Retrieved January 22, 2013, from http://www.unescap.org/tid/publication/swp411.pdf

________________________(2012). Trade cost in Asia and Pacific: Improved and sectoral estimated. *Staff Working Paper*, 1, UNESCAP. Retrieved June 10, 2012, from http://www.unescap.org/tid/publication/swp110.pdf

Harkness, J. & Kyle, J. F. (1975). Factor influencing United State comparative advantage. *Journal of International Economics,* 5(2), 153-165.

Head, K. & Mayer, T. (2002). Illusory Border Effects: Distance mismeasurement inflates estimates of home bias in trade. *CEPII Working papers,* 01.

Helpman, E. (1984). A simple theory of international trade with multinational corporations. *Journal of Political Economy,* 92(3), 451-471.

Helpman, E., Melitz, M. J., & Yeaple S. R. (2003). Export versus FDI. *NBER Working Paper Series,* 9439, National Bureau of Economics Research.

Hoen, A., & Oosterhaven, J. (2006). On the measurement of comparative advantage. *Annals of Regional Science,* 40**,** 677-691.

Hufbauer, G. C. (1970). The impact of national characteristics and technology on the commodity composition of trade in manufactured goods. In R. Vernon (Ed.), *Technology factor in world trade* (145-232). New York, USA: Colombia University press.

Hummels, D. (1999). Toward geography of trade costs. *GTAP Working Papers*, 17. Retrieved June 10, 2012, from http://docs.lib.purdue.edu/gtapwp/17/

Ismail, N. W., Smith, P., & Kugler, M. (2009). The effect of ASEAN economic integration on Foreign Direct Investment. *Journal of Economic Integration*, 24(3), 385-407.

Jack, D. S., Meissner, C., M & Novy, D (2008). Trade cost, 1987-2000. *American Economic Reviews*, 98(2), 529-534.

Johnson, A. (2006). FDI and export: the case of high performing East Asian economies. *Electronic Working Paper Series,* 57, Centre of Excellent for studies in Science and Innovation.

Jongwanich, J. (2010). Determinants of export performance in East and Southeast Asia. *The World Economy,* 33(1), 22-41.

Keretho, S. & Naklada, S. (2011). Analysis of Export and Import Process of Selected Products in Thailand. *Working Paper Series*, 103, Asia-Pacific Research and Training Network on Trade. Retrieved May 7, 2012, from http://www.unescap.org/tid/artnet/pub/wp10311.pdf

Kojima, K. (1982). A macroeconomic approach to foreign direct investment. *Hitosubashi Journal of Economics,* 14(1), 1-21.

Krugman, P. R. & Obstfeld, M. (2005). *International economics: Theory and policy*. Boston: Pearson International.

Leontief, W. (1956). Factor proportions and the structure of American trade: Further theoritical and empirical analysis. *The Reviews of Economics and Statistics*, 38(4), 386-407.

Liu, X., Wang, C., & Wei, Y. (2001). Causal link between foreign direct investment and trade in China. *China Economic Reviews*, 12, 190-202.

Makusen, J. R. (1984). Multinational, multi-plant economies, and gain from trade. *Journal of International Economics,* 16, 205-226.

____________. (2000). Foreign direct investment and trade. *Policy Discussion Paper, No. 19,* Centre for International Economics Studies.

Marjeed, M. T., & Ahmad, E. (2008). Export and FDI in developing countries: Substitutes or compliments? *Pakistan Society of Development Economics*. Retrieved April 5, 2012, from http://www.pide.org.pk/psde23/pdf/Muhammad%20Tariq%20Majeed.pdf

Maule, A. (1996). Some implication of AFTA for Thailand: A revealed of comparative advantage approach, *ASEAN Economic Bulletin,* 13(1), 14-38.

Mayer, T & Zignago, S. (2011). Notes on CEPII's distances measures: The GeoDist database, *CEPII Working papers,* 25.

Moise, E. & Sorescu, S. (2013). Trade facilitation indicators: The potential impact of trade facilitation on developing countries' trade, *OECD Trade Policy Papers*, 144, OECD Publishing. Retrieved January 11, 2013, from http://dx.doi.org/10.1787/5k4bw6kg6ws2-en

Novy, D. (2008). Gravity redux: Measuring of international trade costs with panel data. *Warwick Economic Research Paper,* 861.

OECD (2003). Quantitative Assessment of the Benefits of Trade Facilitation. Retrieved January 13, 2013, from http://vi.unctad.org/files/studytour/strussia10/files /12%20April/Hoffmann%20UNCTAD/OECD_Quantitative%20Assessement%20TF%20benefits.pdf

Pain, N. & Wakelin, K. (1998). Export performance and the role of Foreign Direct Investment. *The Manchester School of Economic and Social Studies*, 66, 26-68.

Phan, P. (2004). *Trade liberalisation and manufacturing performance in Thailand 1990-2000* (Unpbilished PhD dissertation), University of Wallongong, Australia.

Prabir, D. (2006). Why trade cost matter? *Working Paper Series, 7,* Asia-Pacific Research and Training Network on Trade. Retrieved January 10, 2012, from http://www.unescap.org/ tid/artnet/pub/wp706.pdf

Proudman, J., & Redding, S. (2000). Evolving patterns of international trade. *Review of International Economics,* 8**,** 373-396.

Pupphavesa, W. & Pussaransri, B. (1994). FDI in Thailand. *International Economics Relation Program*. TDRI, Bangkok.

Ross, A. K., & E. van Wincoop. (2001). National money as a barrier to trade: The real case for monetary union. *American Economic Review, 91 (2),* 386-390.

Salvatore, D. (2007). *International economics*. 9th ed., Danvers, USA: John Wiley& Sons, Inc.

Sanidas, E., & Shin, Y. (2010). Comparison of revealed comparative advantage indices with application to trade tendencies of East Asian countries. Retrieved on October 12, 2012, from http://www.akes.or.kr/eng/papers(2010)/24.full.pdf

Shepherd, B. (2012). The gravity model of international trade: A user guide. The United Nation: Bangkok.

Shepherd, B., & Wilson, J. S. (2008). Trade facilitation in ASEAN member countries: measuring progress and assess priorities. *Policy Research Working Paper,* 4615, The World Bank.

Stern, R. M., & Maskus, K. E. (1981). Determinants of the structure of United State foreign trade, 1958-76. *Journal of International Economics*, 11, 207-224.

Tambunlertchai, S. (2009). *Foreign direct investment and export performance in Thailand* (Unpublished BA dissertation), Wesleyan University, Connecticut, USA.

Thailand Board of Investment. (n.d.). Automotive Industry in Thailand. Retrieved September 19, 2012, from http://www.boi.go.th/index.php?page=opp_automotive

The World Bank (2013). Doing Business Data. Retrieved on June 3, 2012, from http://www.doingbusiness.org/data/exploreeconomies/thailand#trading-across-borders

Tinbergen, J. (1962). *Shaping the World Economy: Suggestion for an International Economic Policy.* New York, USA: Twenties Century Fund.

UNESCAP. (2002). Trade facilitation handbook: for the Great Mekong subregion. Retrieved January 11, 2013, from http://www.unescap.org/tid/publication/t&ipub2224.pdf

__________. (2007). *Trade Statistics in Policymaking: A Handbook of commonly used trade indices and indicators.* Bankok, Thailand: United Nation Publication.

Vernon, R. (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics,* 80, 190-207.

Vimolsiri, P. (2010). *Thai economic performance and fiscal senarios after financial crisis*. The National Economic and Social Board, Bangkok.

Vollrath, T. (1991). A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Archiv,* 127, 265-280.

Xuan, M. T. & Xing, Y. (2006). Foreign direct investment and exports: the experience of Vietnam. *Economic Development & Policy Series*, EDP06-11.

Yu, R. Cai, J. & Leung, P.S. (2008). The normalized revealed comparative advantage indices. *The Annual Regional Science,* 43 (1), 267-282.

APPENDIX A

Table A. 1 Product groups and description

Code	Description
151	Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats
152	Manufacture of dairy products
153	Manufacture of grain mill products, starches and starch products, and prepared animal feeds
154	Manufacture of other food products
155	Manufacture of beverages
160	Manufacture of tobacco products
171	Spinning, weaving and finishing of textiles
172	Manufacture of other textiles
173	Manufacture of knitted and crocheted fabrics and articles
181	Manufacture of wearing apparel, except fur apparel
182	Dressing and dyeing of fur; manufacture of articles of fur
191	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness
192	Manufacture of footwear
201	Sawmilling and planning of wood
202	Manufacture of products of wood, cork, straw and plaiting materials
210	Manufacture of paper and paper products
221	Publishing
222	Printing and service activities related to printing
231	Manufacture of coke oven products
232	Manufacture of refined petroleum products
233	Processing of nuclear fuel
241	Manufacture of basic chemicals
242	Manufacture of other chemical products

243 Manufacture of man-made fibers

251 Manufacture of rubber products

252 Manufacture of plastic products

261 Manufacture of glass and glass products

269 Manufacture of non-metallic mineral products not elsewhere classified (n.e.c.)

271 Manufacture of basic iron and steel

272 Manufacture of basic precious and non-ferrous metals

281 Manufacture of structural metal products, tanks, reservoirs and steam generators

289 Manufacture of other fabricated metal products; metalworking service activities

291 Manufacture of general purpose machinery

292 Manufacture of special purpose machinery

293 Manufacture of domestic appliances n.e.c.

300 Manufacture of office, accounting and computing machinery

311 Manufacture of electric motors, generators and transformers

312 Manufacture of electricity distribution and control apparatus

313 Manufacture of insulated wire and cable

314 Manufacture of accumulators, primary cells and primary batteries

315 Manufacture of electric lamp and lighting equipment

319 Manufacture of other electrical equipment n.e.c.

321 Manufacture of electronic valves and tubes and other electronic components

322 Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy

323 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

331 Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments

332 Manufacture of optical instruments and photographic equipment

333 Manufacture of watches and clocks

341 Manufacture of motor vehicles

342	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi- trailers
343	Manufacture of parts and accessories for motor vehicles and their engines
351	Building and repairing of ships and boats
352	Manufacture of railway and tramway locomotives and rolling stock
353	Manufacture of aircraft and spacecraft
359	Manufacture of transport equipment n.e.c.
361	Manufacture of furniture
369	Manufacturing n.e.c.

Table A.2 Statistical Summary of Six RCA indices

	BRCA				SRCA				WRCA			
	91-95	96-00	01-05	06-10	91-95	96-00	01-05	06-10	91-95	96-00	01-05	06-10
Mean	1.193	1.066	1.074	1.055	-0.212	-0.204	-0.154	-0.154	1	1	1	1
S.D	1.657	1.391	1.197	1.184	0.512	0.465	0.429	0.408	1.380	1.305	1.114	1.121
Kurtosis	18.954	24.663	23.437	24.010	-1.209	-1.048	-0.681	-0.174	18.898	24.689	23.392	23.990
Skewness	3.720	4.259	4.065	4.198	0.012	-0.033	-0.308	-0.371	3.711	4.261	4.060	4.196
Minimum	0.000	0.000	0.000	0.000	-1.000	-1.000	-0.999	-0.999	0.000	0.000	0.000	0.000
Maximum	10.694	9.555	8.294	8.225	0.825	0.810	0.784	0.783	8.908	8.964	7.715	7.792
Sum	68.007	60.770	61.228	60.139	-12.099	-11.628	-8.785	-8.781	57	57	57	57
	ARCA				NRCA				MRCA			
	91-95	96-00	01-05	06-10	91-95	96-00	01-05	06-10	91-95	96-00	01-05	06-10
Mean	0	0	0	0	0	0	0	0	0	0	0	0
S.D.	0.027	0.023	0.018	0.016	3.913	2.710	2.179	2.370	0.032	0.026	0.021	0.021
Kurtosis	4.072	4.595	3.463	6.952	4.123	4.566	3.466	6.814	3.379	2.996	1.674	3.165
Skewness	0.519	0.920	0.652	0.983	0.535	0.913	0.653	0.887	0.276	0.624	-0.209	-0.572
Minimum	-0.088	-0.067	-0.048	-0.051	-12.591	-7.924	-5.844	-7.880	-0.092	-0.064	-0.056	-0.072
Maximum	0.097	0.083	0.059	0.066	13.845	9.819	7.167	9.772	0.102	0.088	0.054	0.053
Sum	0	0	0	0	0	0	0	0	0	0	0	0

Source: Author’s calculation, 2013

Table A.3 SRCA and its trend

Group	K/L	Rank	ISIC	91-95	96-00	01-05	06-10	Beta	S.E	t	Trend
High capital intensive	20.056	1	232	-0.849	-0.463	-0.208	-0.113	0.050	0.005	9.818***	i
	4.480	2	341	-0.941	-0.674	-0.349	-0.052	0.057	0.002	23.543***	i
	4.064	3	241	-0.698	-0.290	-0.050	0.009	0.047	0.004	11.466***	i
	3.945	4	243	0.056	0.254	0.417	0.458	0.029	0.002	13.599***	i
	1.940	5	292	-0.804	-0.730	-0.656	-0.496	0.020	0.001	14.393***	i
	1.845	6	155	-0.534	-0.561	-0.571	-0.504	0.000	0.002	0.152	s
	1.777	7	271	-0.650	-0.459	-0.384	-0.437	0.015	0.004	4.289***	i
	1.554	8	210	-0.778	-0.440	-0.331	-0.331	0.030	0.004	6.955***	i
	1.504	9	261	-0.148	-0.195	-0.080	-0.145	0.005	0.003	1.701*	i
	1.375	10	343	-0.766	-0.687	-0.346	-0.038	0.049	0.004	13.022***	i
	1.297	11	321	0.208	0.252	0.303	0.263	0.004	0.001	3.163***	i
	1.055	12	153	0.825	0.810	0.784	0.783	-0.004	0.001	-5.658***	d
	1.031	13	269	0.016	0.132	0.210	0.122	0.009	0.003	2.880***	i
Medium-high capital intensive	0.940	14	272	-0.830	-0.520	-0.511	-0.135	0.039	0.006	6.978***	i
	0.861	15	291	-0.272	-0.184	-0.083	-0.030	0.018	0.002	8.949***	i
	0.856	16	323	0.271	0.324	0.305	0.169	-0.003	0.003	-1.281	s
	0.790	17	313	0.035	-0.089	-0.128	-0.212	-0.015	0.002	-7.598***	d
	0.762	18	154	0.423	0.333	0.289	0.257	-0.014	0.003	-5.413***	d
	0.754	19	171	0.209	0.160	0.101	0.052	-0.011	0.001	-11.845***	d
	0.749	20	231	-1.000	-1.000	-0.999	-0.999	0.000	0.000	1.234	s
	0.738	21	342	0.104	-0.705	-0.788	-0.823	-0.060	0.009	-6.685***	d
	0.732	22	242	-0.539	-0.570	-0.569	-0.547	0.001	0.001	0.831	s
	0.727	23	281	-0.209	-0.260	-0.037	0.093	0.017	0.005	3.453***	i
	0.717	24	319	0.004	-0.019	0.174	0.217	0.018	0.004	4.958***	i
	0.704	25	289	-0.289	-0.234	-0.162	-0.077	0.015	0.001	16.424***	i
	0.703	26	312	-0.513	-0.145	0.083	-0.072	0.035	0.006	5.737***	i
	0.667	27	251	0.143	0.241	0.380	0.483	0.023	0.001	24.249***	i
	0.665	28	221	-0.687	-0.777	-0.775	0.066	0.044	0.011	3.851***	i
	0.612	29	152	-0.839	-0.779	-0.543	-0.690	0.012	0.004	3.563***	i
	0.596	30	300	0.238	0.389	0.334	0.453	0.011	0.002	5.051***	i

Medium-high labor intensive	0.589	31	332	-0.099	-0.017	0.047	0.038	0.012	0.003	4.285***	i
	0.570	32	314	-0.312	-0.285	-0.288	-0.247	0.002	0.002	1.524	s
	0.557	33	252	0.198	-0.093	-0.078	-0.080	-0.012	0.005	-2.574**	d
	0.546	34	311	0.052	0.380	0.312	0.027	0.004	0.008	0.478	s
	0.538	35	222	-0.470	-0.713	-0.441	-0.638	0.003	0.008	0.327	s
	0.534	36	293	0.199	0.175	0.278	0.270	0.005	0.002	2.981***	i
	0.495	37	359	0.073	0.222	0.218	0.361	0.022	0.005	4.538***	i
	0.484	38	202	-0.058	-0.040	-0.010	-0.025	0.002	0.001	1.495	s
	0.478	39	333	0.290	0.295	0.294	0.090	-0.010	0.004	-2.670**	d
	0.416	40	182	-0.884	-0.932	-0.846	-0.901	0.003	0.002	1.295	s
High labor intensive	0.415	41	160	-0.979	-0.904	-0.928	-0.926	0.003	0.001	2.663**	i
	0.392	42	315	0.072	-0.149	-0.251	-0.443	-0.038	0.004	-10.076***	d
	0.380	43	172	0.037	-0.058	-0.032	-0.112	-0.009	0.001	-6.842***	d
	0.345	44	322	-0.109	-0.179	-0.241	-0.281	-0.010	0.003	-3.655***	d
	0.341	45	331	-0.714	-0.632	-0.633	-0.567	0.010	0.001	7.350***	i
	0.334	46	351	-0.756	-0.788	-0.711	-0.729	0.006	0.005	1.140	s
	0.323	47	201	-0.593	-0.489	-0.188	-0.067	0.035	0.003	11.310***	i
	0.321	48	151	0.560	0.522	0.458	0.358	-0.014	0.001	-12.310***	d
	0.254	49	173	0.304	0.036	-0.030	-0.185	-0.033	0.003	-10.996***	d
	0.248	50	191	0.553	0.463	0.240	-0.044	-0.039	0.002	-16.807***	d
	0.246	51	361	0.262	0.090	0.079	-0.178	-0.026	0.002	-10.512***	d
	0.233	52	369	0.584	0.372	0.307	0.260	-0.022	0.002	-10.440***	d
	0.193	53	181	0.540	0.296	0.140	-0.112	-0.042	0.001	-34.971***	d
	0.136	54	192	0.593	0.369	0.159	-0.102	-0.044	0.002	-19.960***	d

Source: Author's calculation, 2013

Note: * $p<0.10$, ** $p<0.05$, *** $p<0.01$

i = increase, d = decrease and s = stable

Table A.4 SRCA index and its trend during 1990-2010

SRCA > 0			SRCA < 0		
Code	Description	K/L Rank	Code	Description	K/L Rank
	Group A increase (1990-2010)			Group E increase (1990-2010)	
243	Manufacture of man-made fibers	4	152	Manufacture of dairy products	29
251	Manufacture of rubber products	27	160	Manufacture of tobacco products	41
269	Manufacture of non-metallic mineral products not…	13	201	Sawmilling and planning of wood	47
293	Manufacture of domestic appliances n.e.c.	36	210	Manufacture of paper and paper products	8
300	Manufacture of office, accounting and computing…	30	232	Manufacture of refined petroleum products	1
319	Manufacture of other electrical equipment n.e.c.	24	261	Manufacture of glass and glass products	9
321	Manufacture of electronic valves and tubes…	11	271	Manufacture of basic iron and steel	7
359	Manufacture of transport equipment n.e.c.	37	272	Manufacture of basic precious and non-ferrous metals	14
			289	Manufacture of other fabricated metal products…	25
	Group B decrease (1990-2010)		291	Manufacture of general purpose machinery	15
151	Production, processing and preservation of meat…	48	292	Manufacture of special purpose machinery	5
153	Manufacture of grain mill products, starches…	12	312	Manufacture of electricity distribution…	26
154	Manufacture of other food products	18	331	Manufacture of medical appliances and instrument…	45
171	Spinning, weaving and finishing of textiles	19	332	Manufacture of optical instruments and photographic…	31
333	Manufacture of watches and clocks	39	341	Manufacture of motor vehicles	2
369	Manufacturing n.e.c.	52	343	Manufacture of parts and accessories for motor vehicles…	10
	Group C decrease from >0 (1990-05) to <0 (2006-10)			Group F decrease (1990-2010)	
172	Manufacture of other textiles	43	222	Printing and service activities related to printing	35
173	Manufacture of knitted and crocheted fabrics and articles	49	322	Manufacture of television and radio transmitters…	44
181	Manufacture of wearing apparel, except fur apparel	53		Group G constant (1990-2010)	

191	Tanning and dressing of leather; manufacture of luggage…	50	155	Manufacture of beverages	6
192	Manufacture of footwear	54	182	Dressing and dyeing of fur; manufacture of articles of fur	40
252	Manufacture of plastic products	33	202	Manufacture of products of wood, cork, straw…	38
313	Manufacture of insulated wire and cable	17	231	Manufacture of coke oven products	20
315	Manufacture of electric lamp and lighting equipment	42	242	Manufacture of other chemical products	22
342	Manufacture of bodies (coachwork) for motor vehicles	21	314	Manufacture of accumulators, primary cells and…	32
361	Manufacture of furniture	51	351	Building and repairing of ships and boats	51
	Group D constant (1990-2010)			Group H increase from <0 (1990-05) to >0 (2006-10)	
311	Manufacture of electric motors, generators and…	34	221	Publishing	28
323	Manufacture of television and radio receivers, sound…	16	241	Manufacture of basic chemicals	3
			281	Manufacture of structural metal products, tanks…	23

Note …for more details please see Table A.1

APPENDIX B

Table B.1 Summary of variables statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
exji	264	3255.389	5657.447	44.432	44002.230
exij	264	4292.212	5799.572	128.537	34997.660
gdpj	264	1583768	2584070	91023	13200000
gdpi	264	170434.100	25905.130	131279.500	210076.500
dist	264	6758.152	3781.915	1187.123	13943.400
tji	264	1.042	0.053	1.000	1.331
tij	264	1.162	0.049	1.027	1.257
fdi	264	114.035	375.570	0.000	4331.093
exioj	264	9651.035	4044.250	1910.558	18261.660
wgdpj	264	3712288.000	659460.800	1096860.000	4301252.000
wdist	264	6758.152	180.091	6415.997	7023.438
reer	264	1.229	0.094	1.101	1.368
wtjoi	264	1.030	0.007	1.014	1.038

Table B.2 Hausman test

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpi	2.3314	2.3660	-0.0346	0.1061
lngdpj	1.0006	0.9131	0.0875	0.1963
lnexch	-0.2329	-0.1256	-0.1074	0.1206
lntji	-3.9063	-4.4423	0.5360	0.5835
lnrfdi	0.0054	0.0064	-0.0009	0.0017
crisis	0.0852	0.0777	0.0074	0.0048

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 8.19

Prob>chi2 = 0.2244

(V_b-V_B is not positive definite)

Table B.3 Breusch and Pagan LM test

	Var	sd = sqrt(Var)
lnexij	1.5902	1.2610
e	0.0412	0.2029
u	0.2653	0.5151

Test: Var(u) = 0

chi2(1) = 896.71

Prob > chi2 = 0.0000

Table B.4 Hausman test

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpi	1.6670	1.8168	-0.1497	0.2084
lnwgdpj	0.7550	0.6093	0.1457	0.1485
lnreer	-0.4542	-0.3765	-0.0777	0.0314
lntvioj	-7.4438	-5.1067	-2.3371	2.1124
lnrfdi	0.0205	0.0094	0.0111	0.0036
crisis	0.2674	0.2633	0.0041	0.0142

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 3.46

Prob>chi2 = 0.7488

(V_b-V_B is not positive definite)

Table B.5 Hausman test

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpi	2.5447	2.6872	-0.1424	0.0765
lngdpj	1.3959	1.1523	0.2435	0.1169
lnexch	-0.2688	-0.0853	-0.1834	0.1018
lntij	-0.4159	-0.4125	-0.0034	.
lnrfdi	0.0176	0.0171	0.0005	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 5.51

Prob>chi2 = 0.3570

(V_b-V_B is not positive definite)

Table B.6 Breusch and Pagan LM test

	Var	sd = sqrt(Var)
lnexji	2.0343	1.4263
e	0.0357	0.1891
u	0.3535	0.5946

Test: Var(u) = 0

chi2(1) = 708.37

Prob > chi2 = 0.0000

Table B.7 Share of FDI in Manufacturing Industry by Countries

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Australia	7.49%	0.72%	0.10%	0.03%	0.00%	0.12%	0.00%	0.02%	1.32%	0.03%	0.43%	0.60%
Austria	0.49%	0.00%	0.57%	0.00%	0.27%	0.06%	0.00%	0.08%	0.24%	0.95%	0.82%	0.26%
Belgium	0.07%	0.56%	0.00%	0.18%	0.10%	0.00%	4.85%	0.03%	0.04%	0.25%	7.13%	0.55%
Canada	0.00%	1.43%	0.18%	0.04%	0.00%	0.00%	3.26%	0.99%	0.02%	0.00%	0.15%	0.00%
Denmark	0.00%	0.09%	0.71%	0.14%	0.00%	0.00%	0.24%	0.17%	0.00%	0.00%	0.00%	0.14%
France	0.03%	0.53%	0.52%	0.10%	0.01%	13.69%	0.31%	3.32%	0.04%	0.11%	0.23%	0.13%
Germany	1.78%	0.55%	2.97%	0.95%	0.79%	0.92%	0.63%	2.69%	2.66%	0.03%	0.70%	0.47%
Hong Kong	1.59%	0.69%	0.63%	0.70%	1.05%	1.97%	1.04%	1.10%	3.25%	0.16%	1.00%	0.48%
India	1.04%	0.06%	0.05%	0.04%	0.00%	5.05%	0.00%	0.02%	0.39%	0.00%	2.02%	0.39%
Indonesia	0.00%	0.00%	0.14%	0.00%	0.52%	0.00%	0.00%	0.12%	0.54%	0.00%	0.00%	0.00%
Italy	0.00%	0.01%	0.01%	0.09%	0.51%	1.82%	0.57%	0.06%	0.00%	0.43%	0.12%	0.05%
Japan	67.90%	54.25%	38.38%	39.30%	64.01%	43.84%	47.23%	47.73%	44.76%	39.93%	48.25%	66.25%
Malaysia	1.24%	0.48%	0.43%	1.58%	8.29%	4.51%	0.28%	1.54%	0.55%	1.15%	1.52%	2.37%
Netherland	0.25%	1.53%	6.20%	27.44%	2.39%	0.83%	0.80%	2.91%	5.89%	6.50%	6.80%	1.13%
China	5.40%	0.66%	0.55%	0.67%	0.01%	3.84%	2.14%	4.21%	0.00%	0.51%	2.79%	0.54%
Korea	3.41%	1.14%	0.30%	1.12%	0.57%	0.32%	1.61%	1.13%	2.37%	0.62%	2.44%	1.03%
Singapore	1.34%	4.66%	3.89%	3.21%	9.92%	2.19%	2.24%	2.34%	9.78%	9.91%	5.59%	7.87%
Switzerland	0.00%	1.35%	2.33%	0.62%	0.15%	1.36%	11.00%	1.23%	1.33%	0.60%	0.80%	1.22%
Sweden	0.00%	0.21%	0.00%	0.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.00%	0.04%
Taiwan	2.54%	8.90%	4.39%	4.34%	2.96%	7.12%	4.53%	2.40%	3.39%	2.54%	2.64%	3.47%
USA	3.57%	13.05%	32.42%	15.98%	4.07%	6.11%	3.15%	3.96%	10.69%	19.92%	6.71%	6.61%

UK	0.49%	0.59%	1.34%	0.15%	1.39%	2.05%	9.81%	0.00%	0.43%	9.75%	2.22%	0.96%
Others	1.38%	8.53%	3.88%	2.99%	3.00%	4.22%	6.29%	23.95%	12.31%	6.53%	7.64%	5.44%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Note: FDI is operated FDI

Source: Thailand Board of Investment, 2012

Table B. 8 FDI by industry for three major investors in Thailand 1999-2005 (Million USD)

ISIC	Description	Japan	USA	EU	Others	Total
15	Foods and beverages	316.87	101.24	50.30	285.86	754.27
16	Tobacco products	-	-	-	-	-
17	Textiles	103.28	253.43	61.44	206.50	624.65
18	Wearing apparel; Dressing and dyeing of fur	23.25	10.28	3.68	62.23	99.44
19	Tanning and dressing of leather; Luggage; Handbags;	1.36	0.12	22.94	28.14	52.56
20	Wood and wood products; Cork; Except furniture;	17.19	-	1.19	31.56	49.94
21	Paper and paper products	20.31	14.26	4.83	228.42	267.82
22	Publishing; Printing and reproduction of recorded media	9.40	2.98	-	21.12	33.50
23	Coke oven products, Refined petroleum products and nuclear fuel	37.67	37.67	1.43	-	76.77
24	Chemicals and chemical products	1,347.28	535.08	1,069.05	501.96	3,453.37
25	Rubber and plastics products	780.97	130.99	192.34	568.05	1,672.35
26	Other non-metallic mineral products	245.19	58.87	74.84	145.61	524.51
27	Basic metals	104.00	0.87	0.70	333.74	439.31

28	Fabricated metal products; Except machinery and equipments	915.42	4.67	49.77	472.63	1,442.49
29	Machinery and Equipment n.e.c.	2,320.81	154.57	169.02	653.10	3,297.50
30	Office, accounting and computing machinery	-	-	-	-	-
31	Electrical machinery and apparatus n.e.c.	139.51	75.97	41.46	68.48	325.42
32	Radio; Television; Communication equipment and Apparatus	3,124.75	2,198.73	796.55	2,647.14	8,767.17
33	Medical; Precision and optical instruments; Watches and clocks	89.26	0.07	45.56	13.46	148.35
34	Motor vehicles, Trailers and semi-trailers	2,828.98	46.85	39.56	270.56	3,185.95
35	Other transport equipment	-	-	7.88	15.06	22.94
36	Furniture; Manufacturing n.e.c.	32.44	17.46	40.70	219.73	310.33
37	Recycling	0.95	-	-	7.75	8.70
	Total	12,458.89	3,644.11	2,673.24	6,781.10	25,557.34

Source: Statistics of FDI in ASEAN, 2006

Note: FDI base on approval and appointment

APPENDIX C

C.1 Comprehensive Trade Costs of the Manufacturing industry of Thailand

Table C.1 Comprehensive manufacturing trade cost between Thailand and partner countries ($\sigma_k = 8$) Unit = %

	Countries	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Australia	110.04	106.19	108.86	103.57	99.12	90.73	79.79	73.06	67.02	58.22	56.71	52.05
2	Austria	135.92	151.41	145.94	149.65	135.80	129.37	131.81	124.62	117.45	115.11	122.81	120.94
3	Belgium	98.96	92.22	81.62	51.86	83.83	95.87	92.13	92.46	91.29	88.86	92.39	86.02
4	Canada	137.67	133.27	132.06	129.64	126.58	122.88	120.48	112.96	108.01	97.92	107.24	97.41
5	China	115.86	104.65	104.05	100.79	93.58	85.37	80.17	75.05	70.08	65.04	68.94	61.75
6	Denmark	146.86	140.60	148.04	150.77	146.36	141.81	143.11	135.78	133.80	124.36	128.41	119.77
7	France	124.03	119.52	118.67	124.29	126.04	121.53	109.23	120.00	112.22	107.83	108.12	103.65
8	Germany	112.10	108.22	106.34	109.27	110.48	107.33	107.18	105.25	101.12	96.05	99.42	94.99
9	Hong Kong	84.18	81.28	83.23	80.67	73.97	66.75	65.46	62.29	68.23	51.16	53.46	55.71
10	India	139.12	137.23	132.17	133.68	131.48	127.42	118.59	112.69	107.01	101.08	103.12	97.05
11	Indonesia	110.44	105.20	107.55	107.21	101.21	90.77	85.03	84.62	76.65	68.45	76.94	64.29
12	Italy	143.84	133.79	135.90	136.48	133.92	126.62	128.01	125.68	119.67	114.33	122.47	117.56
13	Japan	75.71	72.10	73.00	71.53	69.67	66.30	63.91	62.54	59.79	55.68	60.29	52.17
14	Korea	107.45	100.72	101.67	100.57	100.47	98.08	97.56	93.00	90.05	84.76	88.58	81.07
15	Malaysia	70.96	67.81	69.46	66.51	64.84	57.70	55.14	52.19	49.28	47.90	49.13	43.17
16	Netherlands	119.71	116.36	115.52	115.27	112.13	103.44	103.00	98.62	96.46	91.78	95.88	92.57
17	Philippines	99.23	81.50	80.63	82.82	78.99	81.28	81.49	77.99	76.84	73.62	78.85	67.62
18	Singapore	54.59	51.79	53.58	53.20	53.42	50.19	46.58	41.83	41.20	35.96	38.41	35.76
19	Spain	160.64	159.60	152.59	159.57	156.38	148.63	142.67	139.69	130.32	123.20	133.28	127.54
20	Sweden	144.36	136.00	140.68	138.47	143.07	143.88	141.96	135.50	132.88	125.21	129.34	123.22
21	Switzerland	127.83	123.75	124.13	123.71	122.43	120.19	117.82	115.26	110.81	103.95	111.00	104.76
22	Taiwan	86.77	82.34	88.27	89.61	85.99	84.74	83.59	77.62	77.26	80.34	85.50	77.99
23	UK	113.31	108.21	109.00	111.74	110.21	107.37	106.25	105.32	100.40	95.63	98.21	93.45
24	USA	86.32	81.26	84.20	88.83	87.33	85.28	82.49	79.52	78.66	76.47	82.94	76.79

Source: Author calculation, 2013

Table C.2 Comprehensive manufacturing trade cost between Thailand and partner countries ($\sigma_k = 11$) Unit = %

	Countries	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Australia	68.12	65.95	67.45	64.48	61.95	57.14	50.78	46.80	43.20	37.88	36.95	34.09
2	Austria	82.36	90.67	87.75	89.73	82.30	78.80	80.13	76.20	72.25	70.95	75.21	74.18
3	Belgium	61.86	58.00	51.85	33.97	53.14	60.10	57.95	58.14	57.47	56.06	58.10	54.41

4	Canada	83.31	80.92	80.27	78.95	77.28	75.25	73.92	69.75	66.98	61.26	66.54	60.98
5	China	71.36	65.09	64.75	62.90	58.78	54.04	51.00	47.98	45.03	42.01	44.35	40.02
6	Denmark	88.24	84.89	88.87	90.32	87.97	85.54	86.24	82.29	81.21	76.06	78.28	73.53
7	France	75.88	73.39	72.92	76.02	76.98	74.51	67.66	73.66	69.33	66.87	67.04	64.52
8	Germany	69.27	67.10	66.04	67.69	68.37	66.60	66.51	65.43	63.09	60.20	62.12	59.59
9	Hong Kong	53.34	51.65	52.79	51.29	47.34	43.04	42.26	40.35	43.93	33.54	34.96	36.34
10	India	84.09	83.07	80.33	81.15	79.96	77.74	72.88	69.60	66.42	63.07	64.22	60.77
11	Indonesia	68.34	65.40	66.72	66.53	63.14	57.17	53.84	53.60	48.93	44.05	49.10	41.55
12	Italy	86.63	81.21	82.35	82.67	81.28	77.30	78.06	76.78	73.48	70.51	75.02	72.31
13	Japan	48.37	46.23	46.77	45.90	44.78	42.77	41.33	40.50	38.83	36.32	39.14	34.16
14	Korea, Rep.	66.66	62.86	63.40	62.77	62.71	61.35	61.06	58.45	56.75	53.68	55.90	51.53
15	Malaysia	45.56	43.67	44.66	42.89	41.89	37.56	35.99	34.17	32.37	31.52	32.28	28.56
16	Netherlands	73.50	71.64	71.18	71.04	69.29	64.40	64.15	61.67	60.43	57.75	60.10	58.20
17	Philippines	62.01	51.78	51.27	52.55	50.31	51.65	51.77	49.72	49.04	47.14	50.23	43.56
18	Singapore	35.65	33.93	35.03	34.80	34.94	32.94	30.69	27.71	27.32	23.99	25.55	23.86
19	Spain	95.53	94.99	91.29	94.97	93.30	89.19	86.00	84.40	79.32	75.42	80.93	77.80
20	Sweden	86.91	82.40	84.93	83.74	86.21	86.65	85.62	82.13	80.72	76.53	78.79	75.44
21	Switzerland	77.96	75.73	75.93	75.70	75.00	73.76	72.45	71.03	68.55	64.69	68.65	65.15
22	Taiwan	54.85	52.27	55.72	56.49	54.40	53.67	53.00	49.50	49.29	51.10	54.11	49.72
23	UK	69.95	67.09	67.53	69.07	68.21	66.62	65.99	65.46	62.68	59.96	61.43	58.71
24	USA	54.59	51.64	53.36	56.04	55.18	53.99	52.36	50.62	50.12	48.82	52.62	49.01

Source: Author calculation, 2013

Table C.3 Comprehensive manufacturing trade cost between Thailand and partner countries ($\sigma_k = 5$) Unit = %

	Countries	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Australia	266.48	254.78	262.85	246.94	233.76	209.54	179.14	161.12	145.37	123.21	119.49	108.19
2	Austria	349.08	401.98	382.99	395.81	348.70	327.50	335.51	312.11	289.40	282.07	306.35	300.39
3	Belgium	233.30	213.79	184.13	107.74	190.23	224.30	213.53	214.47	211.16	204.25	214.27	196.29
4	Canada	354.93	340.30	336.33	328.38	318.43	306.57	298.92	275.43	260.28	230.25	257.95	228.77
5	China	284.41	250.17	248.38	238.69	217.69	194.49	180.19	166.40	153.30	140.30	150.34	132.00
6	Denmark	386.17	364.79	390.25	399.71	384.45	368.90	373.34	348.63	342.06	311.30	324.39	296.69
7	France	310.24	295.90	293.21	311.07	316.71	302.27	263.98	297.42	273.13	259.73	260.63	247.17
8	Germany	272.77	260.93	255.22	264.12	267.82	258.23	257.79	251.97	239.66	224.82	234.66	221.75
9	Hong Kong	191.18	183.21	188.56	181.55	163.53	144.69	141.40	133.36	148.51	106.06	111.59	117.05
10	India	359.79	353.46	336.66	341.65	334.42	321.15	292.96	274.58	257.26	239.55	245.60	227.72

11	Indonesia	267.68	251.82	258.89	257.88	239.92	209.66	193.56	192.40	170.67	149.06	171.45	138.40
12	Italy	375.82	342.01	349.03	350.97	342.46	318.58	323.08	315.54	296.37	279.65	305.24	289.73
13	Japan	168.15	158.58	160.97	157.11	152.23	143.54	137.44	133.97	127.11	116.97	128.35	108.48
14	Korea	258.59	238.48	241.28	238.03	237.73	230.72	229.20	216.01	207.62	192.79	203.48	182.64
15	Malaysia	155.61	147.43	151.70	144.07	139.80	121.92	115.67	108.52	101.60	98.36	101.26	87.39
16	Netherlands	296.48	285.99	283.37	282.59	272.88	246.56	245.24	232.32	226.01	212.53	224.32	214.80
17	Philippines	234.11	183.82	181.44	187.44	176.98	183.22	183.78	174.27	171.19	162.61	176.61	146.92
18	Singapore	114.32	107.59	111.87	110.96	111.50	103.76	95.27	84.33	82.91	71.19	76.61	70.75
19	Spain	434.64	430.92	406.10	430.82	419.47	392.29	371.81	361.74	330.61	307.59	340.33	321.54
20	Sweden	377.60	349.36	365.09	357.63	373.18	375.93	369.40	347.68	339.02	314.04	327.40	307.66
21	Switzerland	322.50	309.35	310.55	309.20	305.12	298.02	290.56	282.55	268.83	248.06	269.40	250.48
22	Taiwan	198.38	186.12	202.60	206.37	196.22	192.73	189.56	173.27	172.32	180.66	194.85	174.29
23	UK	276.51	260.90	263.29	271.66	266.99	258.35	254.97	252.18	237.53	223.61	231.10	217.33
24	USA	197.15	183.16	191.25	204.17	199.96	194.24	186.52	178.41	176.10	170.20	187.75	171.06

C.2 Statistical Summary and Statistical Tests

Table C.4 Statistical summary of variables in model

Variable	Obs	Mean	Std. Dev.	Min	Max
tij	138	92.3393	27.3640	35.7635	143.1146
dist	138	6893.2510	3788.5700	1187.1230	13943.4000
geo_tariff	138	1.0667	0.0197	1.0116	1.1469
geo_docij	138	12.2709	3.1502	7.0000	20.4939
geo_timeij	138	27.9110	7.7963	18.0000	56.4358
geo_conecij	138	43.7365	15.9674	5.6499	79.2604

Table C.5 Statistical summary of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
rexij	138	5927.6040	6989.4520	259.1419	34997.6600
ryi	138	296624.5000	57022.2800	209288.9000	388545.3000
ryj	138	1110556.0000	1708898.0000	12484.3700	7992948.0000
dist	138	6893.2510	3788.5700	1187.1230	13943.4000

rexch	138	24.4499	20.5255	0.0040	73.1277
ex_doci	138	6.6667	1.8016	5.0000	9.0000
im_docj	138	5.3768	1.9750	2.0000	13.0000
time_exi	138	17.8333	4.5040	14.0000	24.0000
time_imj	138	11.3261	7.0980	4.0000	41.0000
conec_i	138	36.3562	3.7072	31.9212	43.7586
conec_j	138	59.3319	33.1098	1.0000	143.5653

Table C.6 Hausman test

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnyi	1.0707	0.8167	0.2540	0.0985
lnyj	0.4096	0.5261	-0.1165	0.1100
lnexch	0.4900	0.1582	0.3318	0.2355
lntji	-1.0603	-1.4126	0.3522	0.5394
lndocij	-0.2195	-0.1828	-0.0367	.
lnconecij	-0.2659	0.2146	-0.4805	0.1827
crisis	-0.0200	-0.0130	-0.0070	0.0052

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 7.31

Prob>chi2 = 0.3974

(V_b-V_B is not positive definite)

Table C.7 Breusch and Pagan LM test

	Var	sd = sqrt(Var)
lnexij	1.30550	1.14258
e	0.01753	0.13239

u	0.57228	0.75649

Test: Var(u) = 0

chibar2(01) = 310.33

Prob > chibar2 = 0.0000

Table C.8 Hausman test

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnyi	0.8626	0.6148	0.2478	0.1156
lnyj	0.4550	0.5481	-0.0931	0.1055
lnexch	0.4444	0.1502	0.2942	0.2252
lntji	-0.6070	-0.9308	0.3238	0.4915
lntimeij	-0.4264	-0.4616	0.0353	0.0241
lnconecij	-0.1169	0.2729	-0.3898	0.1896
crisis	-0.0283	-0.0387	0.0105	0.0080

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 8.37

Prob>chi2 = 0.3008

(V_b-V_B is not positive definite)

Table C.9 Breusch and Pagan LM test

	Var	sd = sqrt(Var)
lnexij	1.30550	1.14258
e	.0164	.1283
u	.4293	.6552

Test: Var(u) = 0

chibar2(01) = 305.11

Prob > chibar2 = 0.0000

C. 3 Derivation of the Anderson and van Wincoop (2003) Gravity Model

The following is Shepherd (2012)'s presentation the derivation of the AvW model.

Production Side

Consider a world of C countries indexed by i. Assuming that countries can trade with each other, and thus that consumers in one country can potentially purchase varieties from any other country. For the moment, trade is costless. Consumers are identical in each country, and maximize CES utility across a continuum of varieties (index v) in K sectors (indexed by k) with the following form:

$$U_i = \sum_{k=1}^{K} \left\{ \int_{v \in V_i^k} \left[x_i^k(v) \right]^{1-\frac{1}{\sigma_k}} dv \right\}^{\frac{1}{1-\frac{1}{\sigma_k}}} \quad (1)$$

The set Vi defines the range of varieties that is consumed in country i. As usual, $x_i^k(v)$ is used to indicate the quantity of variety v from sector k consumed in country i, and $p_i^k(v)$ to indicate its unit price. This function notation is used because of the continuum of varieties. In the version of the model with a discrete number of varieties, v becomes a subscript, and the integrals are replaced with sums.

The utility function is simply the sum of the sectoral sub-utilities, each of which is weighted equally. That restriction can easily be relaxed by aggregating the sectoral sub-utilities via a Cobb-Douglas utility function, and allowing for different weights. So long as the shares are exogenous to the model, however, the basic results stay the same. See Chaney (2008) for an example of what the alternative expressions look like. Anderson and van Wincoop (2003) and Helpman et al. (2008) consider, in effect, a single sector so as to avoid cluttering up the algebra with additional indices. But nothing turns on this, and in the present case it is useful to retain some sectoral disaggregation so that a couple of important data implications that flow from the model in a multi-sector context can be examined. The budget constraint in country i is:

$$E_i = \sum_{k=1}^{K} \left\{ \int_{v \in V_i^k} p_i^k(v) x_i^k(v) dv \right\} \equiv \sum_{k=1}^{K} E_i^k \tag{2}$$

where E_i is total expenditure in that country, and E_i^k is country i's total expenditure in sector k. The consumer's problem is to choose $x_i^k(v)$ for all v so as to maximize (1) subject to (2). The Lagrangian is:

$$\mathcal{L} = \sum_{k=1}^{K} \left\{ \int_{v \in V_i^k} \left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}} dv \right\}^{\frac{1}{1-\frac{1}{\sigma_k}}} - \lambda \sum_{k=1}^{K} \left\{ \int_{v \in V_i^k} p_i^k(v) x_i^k(v) dv \right\} \tag{3}$$

Taking the first order condition with respect to quantity and setting it equal to zero gives:

$$\frac{\partial \mathcal{L}}{\partial x_i^k(v)} = \frac{1}{1-\frac{1}{\sigma_k}} \left\{ \int_{v \in V_i^k} \left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}} dv \right\}^{\frac{1}{1-\frac{1}{\sigma_k}}-1} \left(1-\frac{1}{\sigma_k}\right) \left[x_i^k(v)\right]^{-\frac{1}{\sigma_k}} - \lambda p_i^k(v) = 0 \tag{4}$$

Define, $X^k = \left\{ \int_{v \in V_i^k} \left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}} dv \right\}^{\frac{1}{1-\frac{1}{\sigma_k}}}$, regroup terms, and rearrange to get:

$$\frac{\left[x_i^k(v)\right]^{-\frac{1}{\sigma_k}}}{\int_{v \in V_i^k} \left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}} dv} X^k = \lambda p_i^k(v) \tag{5}$$

Now rearrange again, multiply through by prices, aggregate over all varieties in a given sector, and then solve for the Lagrangian multiplier:

$$p_i^k(v) x_i^k(v) = \lambda^{-\sigma_k} \left[p_i^k(v)\right]^{1-\sigma_k} (X^k)^{\sigma_k} \left\{ \int_{v \in V_i^k} \left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}} dv \right\}^{-\sigma_k} \tag{6}$$

$$\int_{v\in V_i^k} p_i^k(v)x_i^k(v)dv \equiv E_i^k$$

$$= \lambda^{-\sigma_k}\left[p_i^k(v)\right]^{1-\sigma_k}(X^k)^{\sigma_k}\left\{\int_{v\in V_i^k}\left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}}dv\right\}^{-\sigma_k}\int_{v\in V_i^k}\left[p_i^k(v)\right]^{1-\sigma_k}dv \tag{7}$$

$$\lambda = \left\{\frac{\int_{v\in V_i^k}\left[p_i^k(v)\right]^{1-\sigma_k}dv}{E_i^k}\right\}^{\frac{1}{\sigma_k}}\int_{v\in V_i^k}\frac{X_k}{\left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}}dv} \tag{8}$$

To get the direct demand function, substitute this expression for the Lagrangian multiplier back into the first order condition (5):

$$\frac{\left[x_i^k(v)\right]^{-\frac{1}{\sigma_k}}}{\int_{v\in V_i^k}\left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}}dv}X^k = \left\{\frac{\int_{v\in V_i^k}\left[p_i^k(v)\right]^{1-\sigma_k}dv}{E_i^k}\right\}^{\frac{1}{\sigma_k}}\frac{X_k}{\int_{v\in V_i^k}\left[x_i^k(v)\right]^{1-\frac{1}{\sigma_k}}dv}\quad p_i^k(v) \tag{9}$$

$$\therefore x_i^k(v) = \frac{\left[p_i^k(v)\right]^{-\sigma_k}}{\int_{v\in V_i^k}[p_i^k(v)]^{1-\sigma_k}dv}E_i^k \equiv \left\{\frac{p_i^k(v)}{P_i^k}\right\}^{-\sigma_k}\frac{E_i^k}{P_i^k} \tag{10}$$

Where $P_i^k = \left\{\int_{v\in V_i^k}\left[p_i^k(v)\right]^{1-\sigma_k}dv\right\}^{\frac{1}{1-\sigma_k}}$ is the ideal CES price index for sector k in country i.

Production Side

The producer's problem in this model is to maximize profit. Assuming a continuum of firms, i.e. an uncountably large number of them, makes this problem much easier to solve. It turns out that strategic interactions disappear, and firms charge a constant markup. In terms of the overall model, this section gives us an equilibrium pricing equation which, with the equilibrium demand equation derived in the previous section, is just about all necessary to generate gravity.

Each country i has a measure N_i^k of active firms in sector k. Each firm makes a unique product, so the total worldwide measure of products in each sector is $\sum_{i=1}^{k} N_i^k$. To produce one unit of its product, a firm must pay a fixed cost f_i^k and a variable cost a_i^k. With the wage rate equal to w, a typical firm's profit function is therefore:

$$\pi_i^k = p_i^k(v)x_i^k(v) - wa_i^k x_i^k(v) - wf_i^k \tag{11}$$

With a continuum of varieties, it does not matter at this point whether assuming Bertrand (price) or Cournot (quantity) competition. If the firms play Bertrand, the first order condition is:

$$\frac{\partial \pi_i^k(v)}{\partial p_i^k(v)} = x_i^k(v) + p_i^k(v)\frac{\partial x_i^k(v)}{\partial p_i^k(v)} - wa_i^k \frac{\partial x_i^k(v)}{\partial p_i^k(v)} = 0 \tag{12}$$

Solving for prices gives:

$$p_i^k(v) = wa_i^k - \frac{x_i^k(v)}{\frac{\partial x_i^k(v)}{\partial p_i^k(v)}} \tag{13}$$

To do something with that expression, it is required to know more about the partial $\frac{\partial x_i^k(v)}{\partial p_i^k(v)}$. In fact, it can be directly evaluated using the demand function (10) and noting that due to the large group assumption (a continuum of firms) $\frac{\partial P_i^k}{\partial p_i^k(v)} = 0$. In other words, a small change in one firm's price does not affect the overall level of prices in the sector because so many firms are competing. In light of this, it can be written as:

$$\frac{\partial x_i^k(v)}{\partial p_i^k(v)} = -\sigma_k\left[p_i^k(v)\right]^{-\sigma_k-1}\left\{\frac{1}{P_i^k}\right\}^{-\sigma_k}\frac{E_i^k}{P_i^k} = -\frac{\sigma_k x_i^k(v)}{p_i^k(v)} \tag{14}$$

The first order condition for profit maximization can therefore be rewritten as:

$$p_i^k(v) = wa_i^k + x_i^k(v)\frac{p_i^k(v)}{\sigma_k x_i^k(v)} \tag{15}$$

then rearranged and solved for prices to give:

$$p_i^k(v) - \frac{1}{\sigma_k} p_i^k(v) \equiv p_i^k(v)\left(1 - \frac{1}{\sigma_k}\right) = wa_i^k \qquad (16)$$

$$\therefore p_i^k(v) = \left(\frac{\sigma_k}{\sigma_k - 1}\right) wa_i^k \qquad (17)$$

The second term on the right hand side in equation (17) is simply the firm's marginal cost of production. The term in brackets is a constant (within sector) markup: since the numerator must be greater than the denominator, there is a positive wedge between the firm's factory gate ("mill") price and its marginal cost. Since the wedge only depends on the sectoral elasticity of substitution, it is constant across all firms in the sector.

Trade Costs

Thus far, the conditions under which international trade takes place have not been considered. At the moment, the model simply consists of a set of demand functions and pricing conditions for all countries and sectors. As it is, the model describes trade in a frictionless world, in which goods produced in country i can be shipped to country j at no charge. Arbitrage ensures, therefore, identical prices in both countries.

To introduce trade frictions, the common "iceberg" formulation can be used. When a firm ships goods from country i to country j, it must send $\tau_{ij}^k \geq 1$ units in order for a single unit to arrive. The difference can be thought of as "melting" (like an iceberg) en route to the destination. Equivalently, the marginal cost of producing in country i a unit of a good subsequently consumed in the same country i is wa_i^k, but if the same product is consumed in country j then the marginal cost is instead $\tau_{ij}^k wa_i^k$. Using this definition, costless trade corresponds to $\tau_{ij}^k = 1$, and τ_{ij}^kcorresponds to one plus the ad valorem tariff rate. Since the size of the trade friction associated with a given iceberg coefficient does not depend on the quantity of goods shipped, iceberg costs can be treated as being variable (not fixed) in nature.

Taking any two countries i and j, the presence of iceberg trade costs means that the price in country j of goods produced in country i is (from equation (17) above):

$$p_i^k(v) = \left(\frac{\sigma_k}{\sigma_k - 1}\right)\tau_{ij}^k w a_i^k = \tau_{ij}^k p_i^k(v) \tag{18}$$

This result allows us to rewrite the country price index in a more useful (and general) form:

$$P_i^k = \left\{ \int_{v \in V_i^k} \left[\tau_{ij}^k p_i^k(v)\right]^{1-\sigma_k} dv \right\}^{\frac{1}{1-\sigma_k}} \tag{19}$$

Note that this index includes varieties that are produced and consumed in the same country: all

the τ_{ij}^k terms are simply set to unity, so as to reflect the absence of internal trade barriers.

Model Closure: Gravity with Gravitas

These are all the ingredients required to put together a gravity model with gravitas. The trick is in combining them in the right way.

The gravity model is usually concerned with the value of bilateral trade (x_{ij}^k), i.e. exports from country i to country j of a particular product variety. Combining the price equation (19) with the demand function (10) gives:

$$x_{ij}^k(v) = p_i^k(v) x_j^k(v) = \tau_{ij}^k p_i^k(v) \left\{\frac{\tau_{ij}^k p_i^k(v)}{P_i^k}\right\}^{-\sigma_k} \frac{E_i^k}{P_i^k} \equiv \left\{\frac{\tau_{ij}^k p_i^k(v)}{P_i^k}\right\}^{1-\sigma_k} E_i^k \tag{20}$$

The above expression gives us bilateral exports of a single product variety. To derive something that looks more obviously like a gravity equation, it is necessary to aggregate this expression to give total sectoral exports from i to j, i.e. X_{ij}^k . From the production side of the model, it is clear that all firms in a given country-sector are symmetrical in terms of marginal cost, sales, price, etc. Using the measure N_i of firms active in country i, therefore total sectoral exports is written very simply as:

$$X_{ij}^k = N_i \left\{\frac{\tau_{ij}^k p_i^k(v)}{P_i^k}\right\}^{1-\sigma_k} E_j^k \tag{21}$$

Now comes the important part: introducing a general equilibrium accounting identity. It must be the case that sectoral income in country i, Y_i^k, is the income earned from total worldwide sales of all locally made varieties in that sector. Thus:

$$Y_i^k = \sum_{j=1}^{C} X_{ij}^k = N_i \left[p_i^k(v)\right]^{1-\sigma_k} \sum_{j=1}^{C} \left\{\frac{\tau_{ij}^k}{P_j^k}\right\}^{1-\sigma_k} E_j^k \qquad (22)$$

Solving for $N_i\left[p_i^k(v)\right]^{1-\sigma_k}$ gives:

$$N_i\left[p_i^k(v)\right]^{1-\sigma_k} = \frac{Y_i^k}{\sum_{j=1}^{C}\left\{\frac{\tau_{ij}^k}{P_j^k}\right\}^{1-\sigma_k} E_j^k} \qquad (23)$$

Next, substitute that expression back into the sectoral exports equation (21):

$$X_{ij}^k = \frac{Y_i^k\, E_j^k}{\sum_{j=1}^{C}\left\{\frac{\tau_{ij}^k}{P_i^k}\right\}^{1-\sigma_k} E_j^k} \left\{\frac{\tau_{ij}^k}{P_j^k}\right\}^{1-\sigma_k} \qquad (24)$$

For convenience, $\Pi_i^k = \sum_{j=1}^{C}\left\{\frac{\tau_{ij}^k}{P_i^k}\right\}^{1-\sigma_k} \frac{E_j^k}{Y^k}$ define where Y^k is total world output in sector k. Dividing the above expression through by $Y^k$and substituting Π_i^k gives the Anderson and van Wincoop (2003) gravity model:

$$X_{ij}^k = \frac{Y_i^k E_j^k}{Y^k}\left\{\frac{\tau_{ij}^k}{\Pi_i^k P_j^k}\right\}^{1-\sigma_k} \qquad (25)$$

or in the more common log-linearized form:

$$\log X_{ij}^k = \log Y_i^k + \log E_j^k - \log Y^k + (1-\sigma_k)\left[\log \tau_{ij}^k - \log \Pi_i^k - \log P_j^k\right] \qquad (26)$$

APPENDIX D

FDI and trade costs

The result of trade costs in chapter VI shows that trade costs of the manufacturing industry between Thailand and its trading partners are decreasing over time due to the improvement of infrastructure, trade facilitation and trade barriers. Such improvements stimulate many foreign firms to invest in Thailand. Foreign firms also improve trade costs through exports and imports since Thailand is used as an export platform for foreign firms. Thus, there are some requirements from foreign firms that the government of Thailand need to improve infrastructure, regulations and trade facilitation. The issues of causality between FDI and trade costs need to be observed. Thus, the Granger causality test is applied in this paper. The results of the Granger causality test are shown in table 1.

Table 1. Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
lnFDI does not Granger Cause lntrade_costs	242	0.076	0.782
lntrade_cost does not Granger Cause lnFDI		0.075	0.783

The null hypothesis of the Granger causality test is not rejected in two equations which means both variables do not Granger cause each other. However, the conclusion from chapter V indicates that foreign firms invest in Thailand to export to other countries. Trade costs between Thailand and source countries of FDI may not be a significant factor for foreign firms to invest in Thailand. Therefore, trade costs may not cause FDI to Thailand. As a result, the impact of FDI on trade costs is investigated through the following function:

$$t_{ij,t} = f\left(FDI_{ji,t}, EXCH_{ij,t}\right) \qquad (1)$$

where $t_{ij,t}$ is trade costs of the manufacturing industry between Thailand and country j at time t. $FDI_{ji,t}$ is real foreign direct investment in the manufacturing industry from country j to country i (Thailand) at time t. $EXCH_{ij,t}$ is the real exchange rate in terms of Thai Baht per country j's currency. GDP and exports are not included in the model since trade costs are calculated from these variables. Other control variables are not included in equation (1) since they are correlated with FDI. The results of the impact of trade costs on FDI are shown as below:

Table 2. Impacts of FDI on trade costs

Variables	Pooled LS	FE	RE
$lnFDI_{ij,t}$	-0.066***	-0.011	-0.015***
	(0.005)	(0.562)	(0.005)
$lnEXCH_{ij,t}$	0.009	0.125	0.017
	(0.052)	(0.746)	(0.017)
Constant	4.735***	4.359***	4.579***
	(0.028)	(0.374)	(0.072)
	N = 264	N = 264	N = 264
	$R^2 = 0.165$	$R^2 = 0.03$	$R^2 = 0.078$

Note: Standard errors in parentheses,
* p<0.10, ** p<0.05, *** p<0.01

The result of the Hausman test indicates that the random effects model is appropriate[7]. Therefore, the interpretation of the impacts of trade costs on FDI is based on the random effects model. The coefficient of FDI is negatively significant at the 1% level which means a 1% increase of FDI will decrease trade costs of the manufacturing industry between Thailand and its trading partners by 0.015%.

[7] The null hypothesis of the random effects model cannot be rejected since the p-value is higher than 0.05.

The direct impact of FDI on trade costs is from equation (3.36). If FDI increases the manufacturing imports to Thailand, the denominator of trade costs becomes bigger which leads to smaller trade costs. As a result in chapter V, FDI complements the manufacturing imports. In other words, FDI increases the manufacturing imports of Thailand since foreign firms need to import machines and materials from source or other countries. Therefore, the government of Thailand has to motivate foreign firms to invest in Thailand by reducing import tariffs and fees. For this reason, trade costs are decreased. There are also indirect impacts of FDI on trade costs. When a lot of FDI flows into Thailand, the government of Thailand has to upgrade the investment environment by improving infrastructure, transportation and trade facilitation. These factors are important components of trade costs according to the result in Table 6.5. If these factors are improved, trade costs can be reduced.

Although the impact of FDI on trade costs is investigated in this paper, the estimation of trade costs has some limitations. Trade costs are the average trade costs between trade costs from Thailand to its trading partners and trade costs from its trading partners to Thailand. On the other hand, FDI considers only the direction from its trading partners to Thailand. To study the impact of FDI on trade costs, it is necessary to consider the direction of trade costs and FDI. As Thailand is an export platform for foreign firms, trade costs between Thailand and the source countries of FDI may not be as important as trade costs from source countries to the market countries. However, such a study requires detailed data such as route and destination country which are not yet available from any statistical office.