

South Dakota State University
**Open PRAIRIE: Open Public Research Access Institutional
Repository and Information Exchange**

Theses and Dissertations

2017

Intra-Industry Trade in Agricultural Products Between the United States, NAFTA and European Union Trading Partners

Shuvo Chakraborty
South Dakota State University

Follow this and additional works at: <http://openprairie.sdstate.edu/etd>

 Part of the [Economics Commons](#)

Recommended Citation

Chakraborty, Shuvo, "Intra-Industry Trade in Agricultural Products Between the United States, NAFTA and European Union Trading Partners" (2017). *Theses and Dissertations*. 1174.
<http://openprairie.sdstate.edu/etd/1174>

This Thesis - Open Access is brought to you for free and open access by Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. For more information, please contact michael.biondo@sdstate.edu.

INTRA-INDUSTRY TRADE IN AGRICULTURAL PRODUCTS BETWEEN THE
UNITED STATES, NAFTA AND EUROPEAN UNION TRADING PARTNERS

BY

SHUVO CHAKRABORTY

A thesis submitted in partial fulfillment of the requirements for the

Master of Science

Major in Economics

South Dakota State University

2017

INTRA-INDUSTRY TRADE IN AGRICULTURAL PRODUCTS BETWEEN THE
UNITED STATES, NAFTA AND EUROPEAN UNION TRADING PARTNERS

SHUVO CHAKRABORTY

This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science in Economics degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Evert Van der Sluis, Ph.D.
Thesis Advisor

Date

Eluned Jones, Ph.D.
Head, Department of Economics

Date

~~Dean~~, Graduate School

Date

This thesis is dedicated to GOD Almighty, the source and giver of all things.

Also, to my two pillars upon whom my coming to this earth is anchored, Babul

Chakraborty and Tripti Chakraborty. Thanks for giving me the liberty to express myself.

ACKNOWLEDGEMENTS

I acknowledge with great sense of appreciation, the kindness and assistance of my supervisor, Dr. Evert Van der Sluis for creating time to assist me in making corrections which has made this thesis a success. My gratitude also goes to my committee members Dr. Nicole Klein, Dr. Dwight Adamson and Dr. Bradley Bowser.

CONTENTS

ABBREVIATIONS	vii
LIST OF FIGURES	viii
LIST OF TABLES	ix
ABSTRACT	x
Chapter 1: Introduction	1
1.1 Background	1
1.2 Objective of the Study	3
1.3 Justification	3
1.4 Outline	5
Chapter 2: Literature Review	6
2.1 Background	6
2.2 IIT Until 1990	6
2.3 IIT Since 1990	7
2.4 Types of IIT	8
2.5 Determinants of IIT	10
2.5.1 Determinants of IIT for Agricultural Sector	10
2.5.2 Determinants of IIT for the Non-Agricultural sector	14
Chapter 3: Research Design	19

3.1 Theoretical Model for Analyzing IIT.....	19
Chapter 4: Data	25
4.1 Data Sources.....	25
4.2 The IIT Determinants Model.....	25
4.2.1 Model.....	26
4.2.2 The Dependent Variable.....	27
4.2.3 Explanatory Variables and Hypothesis.....	27
Chapter 5: Results.....	33
5.1 IIT Trends for Selected Countries.....	33
5.2 Determinants	41
5.2.1 Model Selection.....	41
5.2.2 Result of the Random Effect Model.....	44
5.3 Limitations and Suggestions for Further Research:	50
Chapter 6: Conclusions and Implications.....	52
Appendix.....	62

ABBREVIATIONS

IIT	Intra-industry Trade	EL	Greece
INT	Inter-industry Trade	HU	Hungary
VIIT	Vertical Intra-industry Trade	IE	Ireland
HIIT	Horizontal Intra-industry Trade	IT	Italy
PPP	Purchasing power parity	LV	Latvia
FDI	Foreign direct investment	LT	Lithuania
AT	Austria	MX	Mexico
BE	Belgium	NL	Netherlands
BG	Bulgaria	PL	Poland
CD	Canada	PT	Portugal
HR	Croatia	RO	Romania
CY	Cyprus	SI	Slovenia
CZ	Czech Republic	SK	Slovakia
DK	Denmark	ES	Spain
EE	Estonia	SE	Sweden
FI	Finland	UK	United Kingdom
FR	France		
DE	Germany		

LIST OF FIGURES

Figure 1:	Total trade volume in the food and live animal industry between the U.S. and selected partner countries.....	36
Figure 2:	IIT indices for trade in the food and live animal industry between the U.S. and selected partner countries for 2007 and 2014.....	40

LIST OF TABLES

Table 1:	Summary of the explanatory variables from studies used in the literature review.....	18
Table 2:	Summary of the variables (all variables expressed in logarithmic form)	32
Table 3:	Summary of the IIT share out of total trade in food and live animal industry.....	34
Table 4:	IIT tendencies by product number between the U.S. and its trading partner for the food and live animal industry.....	38
Table 5:	Hausman test results.....	42
Table 6:	Result of Breusch-Pagan Lagrange multiplier (LM) test for random effects.....	43
Table 7:	Correlation matrix between Dependent and independent variable-----	44
Table 8:	Results of the estimation of the GLS random effect model.....	46

ABSTRACT

INTRA-INDUSTRY TRADE IN AGRICULTURAL PRODUCTS BETWEEN THE
UNITED STATES, NAFTA AND EUROPEAN UNION TRADING PARTNERS

SHUVO CHAKRABORTY

2017

This study provides an overview of trends and identifies country-specific determinants of intra-industry trade (IIT) between the United States (U.S.), the European Union (EU) and the North American Free Trade Agreement (NAFTA) trading partners. We analyze the food and live animal industry at the Standard International Trade Classification (SITC) revision 4 at the 4-digit level to calculate IIT and cover the period between 2007 and 2014. To determine the country-specific determinants of IIT, we used a Generalized Least Squares (GLS) random effect model. Results indicate that the size of an economy, the relative difference in level of economic development, the real exchange rate and research and development (R&D) are positively associated with IIT, while, trade imbalance, geographical distance and available arable land are negatively correlated with the IIT share. The results suggest that countries with relatively large economies, with high levels of per capita income, that are geographically near to one another and with a low trade imbalance are associated with having comparatively high levels of IIT in the food and live animal industry. Results also show an increasing IIT trend for most U.S. trading partners in the food and live animal industry during the period of analysis. IIT and value-added agriculture both involve trade and production of differentiated products, so their increased importance is closely linked. Value-added products involve high profit

margins relative to raw commodities and increased importance of value-added agriculture activities goes hand-in-hand with the growing role of IIT in total international trade in agriculture and food products and it may open the door for additional international trade.

Keywords: Intra-industry trade, United States, European Union, NAFTA, food and live animal industry.

Chapter 1: Introduction

1.1 Background

Trade is the action of buying and selling goods and services. Trade occurs out of necessity, in the sense that one person is not able to produce the variety of products one would like to consume. The system of trade has changed over time. In the early stages of civilization, people traded goods in exchange for other goods based on a barter system, but in modern times, most trade involves the exchange of money. According to the standard models of international trade, much trade between countries is based on their endowments of factors of production. Capital-abundant countries tend to export capital-intensive products and are prone to import labor-intensive products. Similarly, labor-abundant countries are likely to export labor-intensive products and import capital-intensive products. Though the trading system and medium of exchange differs from barter trade, the basic concept of international trade has remained the same.

The export and import of different products based on absolute or comparative advantage is known as inter-industry trade (INT). This trade type is supported by nearly all traditional trade theories. For example, the Heckscher–Ohlin model, the theory of absolute advantage, the theory of comparative advantage, and mercantilism, all concern INT, and were developed between the seventeenth and twentieth centuries. About half of international trade concerns INT, and can be explained by way of these traditional trade theories. However, countries do not always export and import different products, so this leaves the other half of all trade unexplained. Countries also export and import products within the same industry, which is in clear contrast of traditional trade theories. This kind

of trade, especially simultaneous trade of nearly homogeneous products within the same industry, is known as “intra-industry trade” (IIT), first identified by Balassa (1966), and sometimes referred to as “two-way trade” (Anishchenko 2013). Initially, many researchers considered this as a statistical phenomenon rather than a different type of trade, because different industries are often aggregated in trade statistics.

The degree of IIT is not the same for all industries. That is, some industries exhibit high levels of IIT and others experience low IIT levels. Similar levels of exports and imports within one and the same industry are associated with high levels of IIT and large differences between an industry’s exports and imports are associated with low levels of IIT. Theoretically, IIT can be explained through product differentiation and economies of scale. The term “product differentiation” refers to products that are similar but differentiated based on various characteristics (e.g. color, quality, etc.). However, product differentiation alone cannot fully explain IIT, because any country can produce a variety of a product and therefore would not need to engage in IIT. Combining economies of scale and product differentiation may lead to IIT, because the presence of economies of scale within an industry means that each unit of a product can be produced at an increasingly lower cost as its output increases. By specializing in the production of a specific variety of a product, a nation may be able to import other varieties of the same broad product category from other countries.

Empirical studies indicate that IIT is particularly common among industrialized countries, and the share of IIT out of total trade tends to increase between countries as their citizens’ incomes rise. A possible reason for the positive correlation between the IIT

share out of total trade and a nation's per capita personal income is that consumers in relatively high-income countries have greater purchasing power than do their counterparts in low-income countries, so the former can purchase more varieties of products than the latter. As a result, trade between developed countries (DCs) tends to involve higher levels of IIT than trade between DCs and less developed countries (LDCs), although some degree of IIT may exist between DCs and LDCs.

1.2 Objective of the Study

The aim of this study is to investigate the recent trends in intra-industry trade between the United States, 26 countries of the European Union and the two NAFTA partners for products in the food and live animal industry. Second, we seek to identify country-specific determinants of IIT for the same industry.

1.3 Justification

Since IIT was first identified as a distinct phenomenon in 1966, most IIT studies have been limited to the manufacturing sector and industrialized countries, and have mainly focused on the trade between European countries. One reason is the availability of trade data and large trade volumes, and another reason is researchers' interest in changing trade patterns as the European Union evolved. Only a small number of studies focused on the U.S., such as Manrique (1987); Hart and McDonald (1992); and Clark and Stanley (1999). Initial IIT studies focused only on IIT trends, but since 1990 researchers also studied the determinants of IIT. Few researchers studied IIT within the agricultural sector because much trade in agricultural products traditionally involved bulk commodities.

Over the past several decades, there has been an increased interest in value-added agriculture activities. On the agricultural production side, the increased emphasis on value-added products started from the fact that profit margins tend to be higher for such products than for raw commodities and it may be associated with improved production technologies. The increased interest may be also attributed to consumer preferences. Though activities in value-added agriculture increased, it is not possible to entirely replace efficient production of mass quantities with value-added agriculture. Value-added agriculture can only add value to a product by changing the current place, time and product characteristic based on market demand. The growing importance of value-added agriculture has led to the development of increased amounts of differentiated products, which may also be associated with expanded levels of IIT. On the demand side, consumers increasingly demand access to differentiated food products, such as various cheese and wine varieties. While the demand for such differentiated food products provides opportunities for engaging in high-margin value-added food manufacturing activities at the local, regional, and national levels, it also provides opportunities for international trade. This thesis seeks to go beyond the well-documented economic opportunities associated with value-added food manufacturing, by studying the international component of value-added agriculture in the food and live animal industry as reflected by the phenomenon of IIT.

In addition to providing an indication of the role that value-added agriculture achieves in the food and live animal industry, analyzing IIT in the food and live animal industry is important for two reasons. First, studying IIT may provide information not

observable when analyzing INT only, because the latter deals with different products only whereas the former deals with differentiated products. Second, the presence of IIT may provide an indication of the existence of imperfect competition in the industry.

While providing information about the degree of IIT as a share of total trade is useful in itself, it is also important to identify which factors contribute to IIT. Generally, there are two types of IIT determinants – industry-specific and country-specific factors. This study focuses on country-specific determinants by analyzing countries with different income levels and also by emphasizing one industry only.

1.4 Outline

The structure of this thesis is as follows. Chapter 2 contains an overview of the literature pertaining to IIT, both from a theoretical and an empirical point of view. Chapter 3 describes the research design. This part shows different methods for the measurement of the IIT share of total trade. This chapter also describes the panel data and econometric model used to analyze country-specific determinants of IIT. In Chapter 4, we include the description of data. Chapter 5 presents an analysis of IIT patterns and trends and an examination of IIT determinants. Finally, Chapter 6 contains conclusions and suggestions for future study.

Chapter 2: Literature Review

2.1 Background

The concept of IIT was introduced in the 1960s and received public attention after a study by Balassa (1966). IIT is defined as the exchange of similar kinds of products within the same industry. The most acceptable explanation of IIT was put forth by Krugman and Obstfeld (1991) who suggested that economies can specialize to take advantage of increasing returns to scale and engage in international trade, even in the absence of differences in regional physical endowments in factors of production. Trade allows countries to specialize in a limited variety of products and take advantage of increasing returns to scale (i.e., economies of scale) in production, but without reducing the variety of goods available for consumption.

2.2 IIT Until 1990

After Balassa (1966), many researchers used the term IIT, but until 1975 there was no specific method to calculate the degree of IIT. Grubel and Lloyd (1975) first developed a standard method to measure the value of IIT, which involves an adjustment of the model developed by Balassa (1966). Since then, most researchers have used the model developed by Grubel and Lloyd (1975), known henceforth as the G-L index. Sazanami and Hamaguchi (1978) examined IIT patterns in the manufacturing sector between Japan and European Economic Community (EEC) countries between 1962 to 1972. The authors found that IIT in Japan's manufacturing sector with the selected trading partner countries was very low before 1970, but increased since then. Krugman (1979) and Lancaster (1980) developed a theoretical framework to analyze IIT based on

the assumptions of economies of scale and product differentiation which accelerated the theoretical and empirical interest in IIT.

2.3 IIT Since 1990

After the collapse of the Soviet Bloc around 1990, a number of empirical studies were conducted on the changing structure of trade of countries converting from the previous system of state-control toward a more competitive system. The main objectives of those studies were to analyze changing trade patterns, and to document the effects of free trade agreements. The main findings of these studies were trending toward an increased share of IIT out of total trade in agricultural products.

Wang (2009) and Varma (2011) investigated IIT trends for China (1996-2005) and India (2000-2008), respectively. Wang (2009) found that China's IIT was low, but it experienced an upward trend, and Varma (2011) found a slowly increasing trend for India. Fertő (2007) analyzed Hungarian IIT patterns with the EU-15 for agricultural food products during the 1992-1998 period.¹ The author found that while horizontal IIT (HIIT) was low in Hungary, vertical IIT (VIIT) was more common.² Luka and Levkovych (2004) studied different aspects of IIT for the Ukrainian agro-food sector. Using the Grubel-Lloyd (G-L) index, the authors found that IIT values varied significantly by product and trading partner, but in general the level of IIT was very low for Ukrainian agriculture and food trade.

¹ EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

² The differences between HIIT and VIIT are explained in Section 2.4

Qasmi and Fausti (2001) analyzed NAFTA's impact on IIT and INT in agricultural and food products between the United States, Canada, and Mexico and their trade with the rest of the world during the period between 1990 and 1995. They found that trade in food products, especially products involving a relatively large degree of processing, was mainly of the intra-industry type, but trade in bulk commodities with little or no processing consisted primarily of INT. Most of the trade in agriculture and food products between the U.S. and Canada was dominated by IIT during the period (1990-1995) analyzed by Qasmi and Fausti. On the other hand, agricultural and food trade between the U.S. and Mexico was mostly of an inter-industry in nature. The authors also found a decline in the proportion of IIT in U.S. trade with the rest of the world during this period.

2.4 Types of IIT

Majority of the existing research relies on using one of two key methods to explain and analyze IIT. One is to analyze IIT as a whole using the G-L index (Leitão and Faustino, 2008; Rasekhi and Shojaee, 2012; and Łapinska, 2014) and the other method is to analyze IIT by dividing it into two sub-groups or types. This method is used for a relatively more in-depth analysis and has been employed by De Frahan and Tharakan (1998); and Botrić (2013).

IIT is generally divided into two types, HIIT and VIIT. Trade in homogeneous products with limited product differentiation is referred to as HIIT. For example, trade in cars of a similar class and price range. On the other hand, when trade of any good occurs within the same industry at different stages of production, then it is referred to as VIIT

(Grubel and Lloyd 1975). For example, exports of high-quality clothing and imports of lower-quality clothing.

While Crespo and Fontoura (2004) note that the most widely used IIT models involve horizontal differentiation in the context of monopolistic competition, Eaton and Kierzkowski (1984) explain horizontal differentiation in terms of oligopoly. The latter authors assumed the existence of two identical economies and each with two groups of consumers with a different ideal variety of products in their utility function. Each ideal variety in each market has only one producer. Only by engaging in international trade, consumers can obtain other varieties, thus giving rise to IIT.

De Frahan and Tharakan (1998) distinguished between HIIT and VIIT in European food trade. Falvey (1981) first developed a theoretical model for VIIT, under the assumption of perfectly competitive markets with two countries, two goods (a homogenous and a differentiated good) and two factors of production (labor and capital). Falvey (1981) assumed that only the production technology of the homogeneous product differs between countries, so that high levels of capital are used in producing relatively high-quality varieties in the differentiated sector. Thus, the comparatively high-income and capital-abundant country was expected to export relatively high-quality product varieties, while the low-income and labor-abundant country was expected to export low-quality varieties. Falvey's (1981) model excludes an explicit demand side, but Falvey and Kierzkowski (1987) explain this side.

2.5 Determinants of IIT

When analyzing empirical studies, it is common to focus on both earlier and recent studies. In the case of IIT, it is particularly important to focus on relatively recent studies, characteristics and the impact of different components over time, because such studies provide information about currently-relevant conditions. This section is divided into two sub-parts. One discusses IIT determinants for the agricultural sector while another part reviews the determinants of IIT for the non-agricultural sector.

2.5.1 Determinants of IIT for Agricultural Sector

In recent years, several researchers have tried to assess IIT determinants for trade in agricultural products. Most studies focus on common determinants such as GDP, distance, and foreign direct investment, but none incorporate all determinants simultaneously. Jing et al. (2010) analyzed IIT in agricultural products for China between 1997 and 2006. The authors used panel data modeling techniques and included the absolute difference in per-capita GDP between trading partners, differences in physical capital endowments, the average GDP of the two trading partners, cultural similarity and the geographical distance between their capitals as explanatory variables. The authors found that the IIT share out of total trade in agricultural products between China and its 13 main trading partners was low. Regarding the IIT determinants, the authors found that differences in per-capita income and geographical distance each had a negative effect on Chinese IIT in agricultural products, while average GDP of the two trading partners and cultural similarity each had a positive impact on Chinese IIT in agricultural products.

However, the variable measuring differences in physical capital endowments was insignificant.

In a study on the determinants of IIT in the food processing sector of Portugal, Leitão and Faustino (2008) used both industry and country-specific characteristics as explanatory variables, including energy consumption, minimum GDP, maximum GDP, geographical distance, horizontal product differentiation, minimum efficient scale (the production allocation at which a firm's long-run average cost is minimized), foreign direct investment (FDI) inflows and the trading partner's trade imbalance to explain the G-L index as dependent variable.³ The authors covered the 1995-2003 period and found that differences in GDP per capita, geographical distance and FDI inflows explained IIT patterns. FDI and differences in GDP per capita each had a positive impact on IIT and geographical distance had a negative impact on IIT.

Following Leitão and Faustino (2008), Rasekhi and Shojaee (2012) studied factors determining VIIT in the agricultural sector for Iran with its main trading partners during the time period between 2001 and 2007. The authors first measured the types of IIT and then assessed the determinants of vertical and total IIT in the agricultural sector using panel data modeling techniques. They used methods developed by Greenaway, Hine and Milner (GHM) applied to a 6-digit Harmonized System (HS) product classification and then analyzed the determinants of total IIT and VIIT using theoretical

³ Minimum GDP refers to the logarithm of the lower value of GDP (Purchasing Power Parity (PPP), in current international dollars) between Portugal and its EU partners. Maximum GDP denotes the logarithm of the higher value of GDP (PPP, in current international dollars) between Portugal and its EU partners.

and experimental models. The authors used level of development, difference in GDP per capita, average GDP, difference in factor endowments, the real exchange rate, and market size difference as independent variables and found economic development and difference in GDP per capita had positive and significant effects on Iran's bilateral IIT. However, factor endowments, the real exchange rate, average GDP, market size differences each impacted the IIT negatively.

Łapinska (2014) reported similar results as those found by Rasekhi and Shojaee (2012) in investigating the country-specific determinants of IIT between Poland and its EU trading partners in agricultural and food products. Her study covered the time period between 2002 and 2011. In 2004, shortly after the beginning of the period of analysis, Poland joined the EU. The author found that agricultural and food products played an important role in Poland's trade with other EU member states. The author also found that the intensity of IIT in agricultural and food products was positively influenced by the intensity of trade with other EU countries. That is, IIT shares were high for those trading partners with which Poland engaged in relatively large amounts of trade (e.g. Germany). The author found that Poland's IIT with other EU member nations increased as a result of its EU membership. She further found that IIT increased in particular with the trading partners with similar Slavic-based languages (related languages and comparable cultures may involve similar kinds of taste). The author found that the degree of the trade imbalance between trading partners, relative differences in the size of the economies and relative differences in levels of economic development each had a negative impact on IIT.

In an analysis on the structure of trade in India's processed agri-food products with members of the South Asian Preferential Trade Agreement (SAFTA) and selected members of the Association of Southeast Asian Nations (ASEAN), Varma and Ramakrishnan (2014) found that India engaged in IIT in processed food products with all member countries studied. Bangladesh, Bhutan, Nepal, Sri Lanka and Singapore had relatively higher levels of IIT with India than did the other countries studied. The authors used export and import data based on the Harmonized System (HS) of classification taken from the World Integrated Trade Solution (WITS) database, jointly developed by the World Bank, the United Nations' Conference on Trade and Development (UNCTAD), and India's Ministry of Commerce. The authors covered the period between 2003 and 2011 and considered the four-digit level of the HS classification in their calculations, and used a tobit model as well as a random-effects model. The authors found that both country-specific and industry-specific factors had impacts on India's IIT. The authors used the difference in per capita income between trading partners, differences in economic size, difference between the size of partner countries (population), geographical distance, and participation in free trade agreements as explanatory variables. They found negative impacts on IIT due geographical distance and difference in economic size, while the difference in country size, and membership in a free trade agreement each had a positive impact on IIT.

Jámbor (2015) analyzed country and industry-specific determinants of HIIT and VIIT in agri-food products between the Visegrad countries (the Czech Republic, Hungary, Poland and the Slovak Republic) and the European Union during the 1999-

2013 period. All four countries became members of the EU in 2004. The author used the absolute difference in per capita GDP between trading partners, the absolute difference in agricultural area per capita between trading partners, the absolute difference in per capita agricultural labor between trading partners, the absolute difference in per capita agricultural machinery between trading partners, the distance between trading partners' capital cities, the percentage of the labor force employed in the agri-food industry, FDI, and the contribution of value-added agriculture to GDP as explanatory variables. Jámbor found that IIT was mainly of a vertical nature in the Visegrad countries, though the majority of their exports consisted of low-quality value-added agri-food products to the EU markets. The results were obtained by way of a generalized method of moments (GMM) model applied to panel data. The author found that the absolute difference in agricultural area per capita between trading partners, FDI, value-added agriculture and distance were negatively related to IIT, whereas the absolute difference in per capita GDP, the absolute difference in per capita agricultural machinery, the absolute difference in per capita agricultural labor between trading partners were positively related to IIT.

Key common determinants from the above-mentioned studies were used in the current study to analyze the determinants of IIT in agricultural sector. These common variables are difference in per capita income, difference in economic size, difference in factor endowments, geographical distance, and FDI.

2.5.2 Determinants of IIT for the Non-Agricultural sector

Since 1990, many researchers have tried to explain what determines IIT, but most of these studies were related to non-agricultural sectors. Clark and Stanley (1999) sought

to identify country and industry-level determinants of IIT between the United States and 155 developing countries between 1970 and 1992. Using the G-L index to measure IIT, the author found that 50 percent of trade in manufactured goods between the U.S. and the 155 developing countries and territories consisted of IIT, and trade between the U.S. and the 30 largest developing countries involved 48.5 percent IIT. To analyze the determinants of IIT, many previous studies used OLS regression specifications, with a mix of log linear and logistical functional forms, but Clark and Stanley used limited dependent variable modeling technique applied to panel data to analyze the determinants of IIT. The authors found that factor endowment differences and distance had negative effects on IIT, and the size of the trading partner (population), the number of industrial establishment proxied as industry size, advertising intensity, and industrial participation in offshore assembly provisions (OAP), were positively correlated with IIT.

Following Clark and Stanley (1999), Leitão and Faustino (2009) studied the determinants of IIT in the automobile sector between Portugal, the EU-27 (not including Croatia), the BRIC (Brazil, Russia, India and China) countries, and the United States. They covered the time period between 1995 and 2006. Using panel data, the authors analyzed the impact of different country-specific determinants on IIT. Variables used in this study were the difference in per-capita GDP, difference in physical capital endowments as measured by difference in electric power consumption (Kwh per capita) between Portugal and its partners, average GDP of the two trading partners, and geographical distance between Portugal and the partner country. The authors found a negative correlation between differences in factor endowments and IIT, which indicates

that IIT occurs more frequently in the trade between countries with similar factor endowments. They also found that distance had a negative impact on IIT while differences in per-capita GDP and average GDP were positively correlated with IIT.

Shahbaz and Leitão (2010) analyzed some of the determinants of Pakistan's IIT for the manufacturing sector between 1980 and 2006. The authors used a fixed effect model as a static modeling approach and a Generalized method of moments (GMM) system as a dynamic approach for analyzing country-specific determinants of IIT. The authors used country-specific characteristics as explanatory variables, including economic differences between countries, minimum GDP, maximum GDP, average GDP per capita, geographical distance, foreign direct investment inflows, and trade imbalances. The authors found that average GDP per capita had a positive impact on IIT. They also found that economic differences, geographical distance and the presence of a trade imbalance had negative impacts on IIT.

Botrić (2013) used a panel GLS method to analyze IIT in manufacturing products between nations in the Western Balkans and the old European Union member states over the period from 2005-2010.⁴ This model allowed the author to account for heteroskedasticity across countries and also to correct for possible correlations between the independent variables and the constant term. The author used the presence of a common border, distance, relative factor endowments, relative trading costs, total employment, gross fixed capital, and export time as independent variables. Botrić found

⁴ “The Old European Union” member states are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and UK.

that all the variables were significant. Having a common border, employment, gross fixed capital had positive impacts on IIT, while relative trading costs, relative factor endowments, export time and distance had negative impacts on IIT.

The empirical studies reviewed in this chapter show various aspects of IIT. While some studies focus on finding IIT values, others identify factors that influence the intensity of IIT. The majority of the research on IIT analyzes the manufacturing sector, but after 1990 there was an increased focus on the agricultural sector. While several studies on IIT were published before 1975, the main focus of this review is on relatively recent studies to get a sense of current IIT trends. While the IIT literature is extensive, papers selected here largely focus on European countries or NAFTA partners, and nations most closely related to the ones analyzed in the current study. Most previous studies involve analyzing country-specific determinants of IIT for the agricultural and non-agricultural sectors, and used a series of common determinants as summarized in Table 1. Those are relative GDP per capita, distance between countries, FDI, differences in factor endowments, and differences in economic size. In most cases, researchers used panel data to model and analyze IIT.

Table 1: Summary of the explanatory variables from studies used in the literature review

VAR\Study	Lapinska (2014)	Jing et al. (2009)	Leitão & Faustino (2008)	Rasekhi & Shojaee (2012)	Varma & Rama-krishnan (2014)	Jámbor (2015)	Clark & Stanley (1999)	Leitão & Faustino (2009)	Botrić (2013)	Shahbaz & Leitão (2010)
GDP (Size of Economy)	+						+			
GDP Per Capita	+	-		+						
GDP difference	-				-			-		-
Per Capita Income Dif.	-		+	+	+					
EU Membership	+									
Trade Imbalance	-			-			-			-
FDI			+							
Trade Intensity	+									
Language (Culture)	+	+								
Distance	-	-	-		-	-	-	-	-	-
Avg. GDP		+		-				+		+
Factor Endowments				-		-	-	-	-	
Real Exchange Rate				-						
Market Size (population)				+	+					
FTA					+					
Dif. in Per Capita Ag. Machinery						+				
Dif. in Per Capita Ag. Labor						+				
Border									+	
Employment Share									+	
Gross Fixed Capital									+	
Export Cost									-	
Land				-						

Source: own composition.

Chapter 3: Research Design

3.1 Theoretical Model for Analyzing IIT

The previous review of selected empirical studies indicates that there are several methods for measuring IIT. Prior to the formal identification of IIT as a distinct phenomenon, Verdoom (1960) used the export-to-import ratio within one and the same industry to measure the IIT extant as follows:

$$V_m = \frac{X_m}{M_m}, \quad [1]$$

where V_m denotes the Verdoom index, X_m represents the value of exports for industry m , and M_m denotes the value of imports of industry m . However, this ratio does not provide a direct measure of the proportion of IIT to total trade.

Michaely (1962) proposed a model to measure the trade pattern of a particular industry, subsequently known as the Michaely index:

$$M_i = \frac{\sum_{m=1}^n X_m}{\sum X_m} - \frac{M_m}{\sum M_m}, \quad [2]$$

where M_i = Michaely index, $\sum X_m$ = total exports and $\sum M_m$ = total imports with industry m . The M_i value ranges between zero and one. However, because it is only a ratio and does not depend on total trade, the Michaely index fails to provide any absolute amount of total trade and its value provides no information about IIT.

Balassa (1966) proposed a revised version of the Michaely index, subsequently known as Balassa index:

$$B_m = \frac{|X_m - M_m|}{(X_m + M_m)}, \quad [3]$$

where B_m is the Balassa index, which is negatively related with IIT. Its minimum value is zero when all trade is of the intra-industry type, and unity when there is no IIT. Grubel and Lloyd (1975) criticized the Balassa index, because it fails to explain aggregate trade imbalances. The Balassa index also assigns equal weights to all industries, regardless of their contribution in total trade.

Helpman and Krugman (1985) modeled IIT using the Chamberlin-Heckscher-Ohlin (C-H-O) framework.⁵ Their IIT model is a combination of the Heckscher-Ohlin (H-O) model and monopolistic competition. The C-H-O model includes factor endowments, increasing returns to scale, and horizontal product differentiation. The basic H-O model considers two countries and two goods, where one country is capital-abundant and the other is labor-abundant. One of the goods is capital-intensive, and the other is labor-intensive. While the basic H-O model explains INT, the C-H-O model can explain IIT as well. Davis (1995) believed that for IIT, the existence of increasing returns to scale is not mandatory and that IIT could also occur with constant return to scale. He also believed that it would be possible to explain IIT using the Heckscher-Ohlin and Ricardian frameworks. The author showed that if trade of different goods relies on the same kind of factor intensity, a large production and amount of trade of those goods may lead to substitution possibilities in production under the assumption of preference

⁵ The Chamberlin-Heckscher-Ohlin framework integrates Chamberlin's monopolistic competition into the H-O model and it was made popular by Helpman and Krugman (1985). Chamberlin's monopolistic competition is a market structure where multiple producers act as monopolists, though the market itself is in perfect competition.

indifference between products. In that case, small technical differences may lead to specialization and to IIT.

Most empirical studies on IIT use Grubel and Lloyd's (1975) method for determining the extent of IIT, known as the G-L index, written as:

$$\beta_m = \frac{(X_m + M_m) - |X_m - M_m|}{(X_m + M_m)}. \quad [4]$$

Equation [4] can be rewritten as:

$$\beta_m = 1 - \frac{|X_m - M_m|}{(X_m + M_m)}, \quad [5]$$

where β_m is the Grubel–Lloyd index of IIT for industry m , X_m represents a country's exports in industry m , and M_m denotes a country's imports for industry m .

The G-L index reaches its maximum value of one if and only if the total amount of exports and imports become the same, indicating that all trade consists of an IIT type. The G-L index will reach its minimum value zero if and only if either the value of exports or the value imports is equal to zero, indicating that all trade is in different products and thus fully comprises INT. The weighted average of the indexes for individual industries (β_m) is used to calculate an aggregate measure of IIT. Weights must be each of the industries' shares out of total trade, i.e., $(X_m + M_m) / \sum_{(m=1)}^n (X_m + M_m)$.

The formula for the aggregate measure of IIT is given as:

$$\beta_m = \frac{\sum_{(m=1)}^n (X_m + M_m) - \sum_{(m=1)}^n |X_m - M_m|}{\sum_{(m=1)}^n (X_m + M_m)}. \quad [6]$$

However, in the presence of a trade imbalance, the G-L index may become biased (Qasmi and Fausti 2001; and Greenaway et al. 1986). Because exports virtually never

equal imports, the nature of trade cannot be fully of the intra-industry type. This may result in an error when considering the aggregate IIT measure for imbalanced trade. For this reason, Grubel and Lloyd (1975) suggested making an adjustment to the index given in Equation (4), whereby IIT is expressed as a proportion of total exports of the good plus imports of the goods less the trade imbalance, derived as follows:

$$C_m = \frac{\sum_{(m=1)}^n (X_m + M_m) - \sum_{(m=1)}^n |X_m - M_m|}{\sum_{(m=1)}^n (X_m + M_m) - |\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|} \quad [7]$$

Equation 7 can be simplified as follows,

$$C_m = \frac{\sum_{(m=1)}^n (X_m + M_m) - \sum_{(m=1)}^n |X_m - M_m|}{\sum_{(m=1)}^n (X_m + M_m)} \cdot \frac{\sum_{(m=1)}^n (X_m + M_m)}{\sum_{(m=1)}^n (X_m + M_m) - |\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|}$$

$$C_m = \beta_m \cdot \frac{\sum_{(m=1)}^n (X_m + M_m)}{\sum_{(m=1)}^n (X_m + M_m) - |\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|} \quad [\text{from equation 6}]$$

$$C_m = \beta_m \cdot \frac{1}{\frac{\sum_{(m=1)}^n (X_m + M_m) - |\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|}{\sum_{(m=1)}^n (X_m + M_m)}}$$

$$C_m = \beta_m \cdot \frac{1}{\frac{\sum_{(m=1)}^n (X_m + M_m)}{\sum_{(m=1)}^n (X_m + M_m)} - \frac{|\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|}{\sum_{(m=1)}^n (X_m + M_m)}}$$

$$C_m = \beta_m \cdot \frac{1}{1 - Z_m}, \quad [8]$$

where $Z_m = \frac{|\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|}{\sum_{(m=1)}^n (X_m + M_m)}$, and C_m = the adjusted Grubel–Lloyd measure of IIT

for industry m . This adjusted Grubel-Lloyd (G-L) index also reaches its maximum value of one when the difference between the value of exports and imports is equals to zero and reaches its minimum of zero when either the value of exports or imports equals to zero.

Hamilton and Kniest (1991), Greenaway et al. (1994), and Brühlhart (1994) note that when measuring IIT using the G-L index of Equation 5, it becomes “static”. That is,

it measures the trade structure at a certain point of time. On the other hand, if IIT is measured using an intertemporal comparison of the G-L indexes, it becomes “comparative static,” because it compares the trade structure at different points of time. The costs of adjustment depend on the structure of the change in trading patterns.⁶

Brühlhart (1994) proposed alternative indexes of marginal intra-industry trade (MIIT);

$$B_m^A = 1 - \frac{|\Delta X_m - \Delta M_m|}{|\Delta X_m| + |\Delta M_m|}, \quad [9]$$

where Δ is the difference operator, and B_m^A = MIIT of industry m . Like the G-L index, it can also be summed across the same industry, so that

$$B_m^A = 1 - \frac{|\Delta X_m - \Delta M_m|}{\sum_{i=1}^k (|\Delta X_m| + |\Delta M_m|)}. \quad [10]$$

The weighted average of MIIT over several industries is B^A .

Since 1960, different methods were developed to determine the IIT value, among them the G-L index developed by Grubel and Lloyd (1975) is widely accepted and used in most empirical studies. Finger (1975) supported the use of the unadjusted G-L index for measuring IIT and expressed doubt towards the adjusted G-L index. He noted that the primary reason for making the adjustment to the G-L index was to deal with a trade imbalance, but the adjustment could be misleading if any adjustment contains any invalid implicit assumptions about the effect on trade patterns.⁷ Vona (1991) proved that the

⁶ The adjustment costs are those associated with factor market adjustment, particularly involving the labor market.

⁷ If G-L index is used to evaluate the validity of the factor proportions theory or any other theory, the unadjusted measure provides better result in the sense that, if any adjustment contains implicit assumptions about the effect on trade patterns of eliminating the phenomena being adjusted for, the “adjusted” figures could be misleading because of the invalidity of these implicit assumptions (Finger 1975).

unadjusted G-L index provides the best outcome, because adjustment for trade imbalance leads to an index which produces higher values than the unadjusted one which is misleading and the adjusted equation sometimes also failed to reach its maximum value because in some cases $\sum_{(m=1)}^n |X_m - M_m| = |\sum_{(m=1)}^n X_m - \sum_{(m=1)}^n M_m|$ [in equation 7]. Hence, in this thesis we use the unadjusted G-L index to determine the value of IIT.

Chapter 4: Data

4.1 Data Sources

The main source of trade data is the United Nations' Commodity Trade database (UN Comtrade database). For GDP-related data, we used the World Bank database and the Research and Expertise on the World Economy (CEPII) database for measuring the distance between countries' capital cities in kilometers. We analyzed data covering the time period between 2007 and 2014. This study covers the SITC revision 4 classification code 0 (food and live animals) and all of its subcategories at the 4-digit level.⁸ Because the G-L index does not determine a cut-off value for classifying product categories as being of the intra-industry or inter-industry type, we classified the product lines into 4 categories, based on previous work by Qasmi and Fausti (2001). Values between 0.00 and 0.24 denote having strong inter-industry tendencies, values between 0.25 and 0.50 indicate weak inter-industry tendencies, values from 0.51 to 0.74 suggest weak intra-industry tendencies and values between 0.75 and 0.99 indicate strong intra-industry tendencies.

4.2 The IIT Determinants Model

We constructed a panel data set to analyze the determinants of U.S. IIT in the food and live animals industry with EU and NAFTA trading partners. We used the G-L index to assess IIT during the 2007-2014 period as dependent variable. We calculated

⁸ The Standard International Trade Classification (SITC) is a classification of goods used to classify the exports and imports of a country to enable comparing different countries and years. The classification system is maintained by the United Nations. The SITC system is currently at revision four, which was promulgated in 2006 (Wikipedia).

two-way trade indices for SITC revision 4 at the 4-digit commodity level. SITC 0 represents food and live animals and its 4-digit sub-categories were covered in this study. The study includes 28 trade partners of the U.S., among them 26 EU countries and the two NAFTA partners. Two EU countries, Luxembourg and Malta, were eliminated from this study because of the unavailability of all necessary data.

4.2.1 Model

We used a panel regression model to analyze the data. In constructing the model, we used the determinants highlighted in Łapinska (2014) and the other studies described in the literature review.

The general form of our model is: $B_{uat} = f(GDP, DGDPPC, TIMB, FDI, DIST, EXRT, R\&D, ARB)$, and the empirical form of our model is:

$$B_{uat} = \beta_0 + \beta_1 GDP_{at} + \beta_2 DGDPPC_{uat} + \beta_3 TIMB_{uat} + \beta_4 DIST_{uat} + \beta_5 FDI_{at} + \beta_6 EXRT_{uat} + \beta_7 R\&D_{at} + \beta_8 ARB_{at} + V_{at}, \quad [10]$$

where u denotes the U.S., a represents the trading partners of the U.S., t denotes time, B_{uat} is a logistic transformation of G-L index, GDP_{at} denotes the size of the economy of the trading partner of the U.S., $DGDPPC_{uat}$ refers to the relative difference in the U.S. and partner country's size of GDP per capita, $TIMB_{uat}$ stands for the degree of trade imbalance, FDI_{at} symbolizes the foreign direct investment inflow of a partner country, $DIST_{uat}$ represents distance between capital cities of the U.S. and its trading partners, $EXRT_{uat}$ designates the real exchange rate in current USD between the U.S. and its trading partner, $R\&D_{at}$ stands for the research and development cost as a percentage of

GDP in the partner country, ARB_{at} denotes the available arable land in the partner country, and V_{at} is a random error.

4.2.2 The Dependent Variable

To analyze the determinants of IIT, we use the G-L index as the dependent variable. Thorpe and Leitão (2013); and Faustino and Leitão (2007) are among the few researchers who have used the G-L index as dependent variable, but using the G-L index as dependent variable always leads to a possibility of getting a value beyond the theoretically acceptable range, that is, between zero to one (Łapinska 2014; and Sichei et al. 2007). To avoid this possibility, we use the approach followed by Balassa and Bauwens (1987) and Leitão and Faustino (2009), and apply a logistic transformation of the G-L index. The resulting index $\ln(\beta_{uat}/(1 - \beta_{uat}))$ eliminates the possibility of obtaining a G-L index value beyond the acceptable range. Its logistic transformation β_{uat} represents IIT and $(1 - \beta_{uat})$ denotes INT. More specifically, β_{uat} is the G-L index between the U.S. and its trading partner a at time t . As noted in Chapter 3, we use the unadjusted method to estimate the G-L index because it provides more accurate results than using adjusted G-L index (Vona 1991).

4.2.3 Explanatory Variables and Hypothesis

In order to analyze the country-specific determinants of IIT, all variables were expressed in logarithmic form. Table 2 lists a summary of all variables. GDP_{at} is the trading partner's gross domestic product, which represents the market value of all final goods and services produced within the national boundaries during the specific time

period t , and is expressed in current USD. It is used as a proxy for measuring the size of the economy of U.S. trading partner a . If other things remain unchanged, an increase in the size of a partner's economy is associated with an increase in the share of IIT. This is supported by Łapinska (2014) and Clark and Stanley (1999), who found a positive relationship between the size of a partner country's economy and its IIT share. Hence, our first hypothesis is that there is a positive relationship between a trading partner's economic size and IIT.

$DGDPPC_{uat}$ measures the relative difference in the U.S. and partner country a 's GDP per capita. Following Zhang and Li (2006), it is calculated as:

$$DGDPPC_{uat} = 1 + \frac{[w \ln w + (1-w) \ln(1-w)]}{\ln 2},$$

where $w = \frac{GDPPC_U}{GDPPC_U + GDPPC_a}$ is the ratio of the U.S. GDP per capita to total GDP per capita of the U.S. and the partner country. This variable was also used in other empirical studies. For example, Türkcan (2005) found a negative relationship between DGDPPC and the IIT of final goods, but for IIT in intermediate goods it was ambiguous. Helpman and Krugman (1985) used differences in the capital-labor ratio rather than DGDPPC and found a negative relationship as well. Falvey and Kierzkowski (1987); Balassa and Bauwens (1987); and Jambor (2014) also considered differences in per capita income as a proxy for factor endowment differences. However, Leitão and Faustino (2008); Rasekhi and Shojaee (2012); and Varma and Ramakrishnan (2014) found positive relationships between DGDPPC and the IIT share out of total trade. Thus, the second hypothesis is that

we expect a negative correlation between the relative difference in income per capita (DGDPPC) of the U.S. relative to that of its trading partner and the IIT intensity.

Grubel and Lloyd (1975) pointed out that IIT is affected by the trade imbalance of a country. Therefore, we incorporate a variable to capture the degree of the trade imbalance between the U.S. and its trading partners. Following Lee and Lee (1993), the trade imbalance is calculated as:

$$TIMB_{uat} = \frac{|X_{ua} - M_{ua}|}{(X_{ua} + M_{ua})},$$

where X_{ua} represents exports between the U.S. and partner country a , and M_{ua} denotes imports between the U.S. and partner country a . The lowest value of the trade imbalance is zero, which is only possible if and only if there is no export or import (considering $X_{ua} \neq M_{ua}$, or it will be balanced trade). Łapinska (2014) analyzed the impact of the trade imbalance on the IIT share for Poland and its trading partners and found a negative relationship. In other studies, Leitão (2011); Clark and Stanley (1999); Shahbaz and Leitão (2010) and Ekanayake et al. (2007) found an inverse relationship between a nation's trade imbalance and its IIT share. Hence, in line with previous studies, our third hypothesis is that there is an inverse relationship between TIMB and the IIT share.

FDI_{at} represents the foreign direct investment inflow into partner countries (in current USD). Previous studies have found a mixed impact of FDI on the share of IIT. Greenaway et al. (1994); and Faustino and Leitão (2007) found a positive relationship, while Shahbaz and Leitão (2010) found an ambiguous relationship between the IIT share

and FDI. Therefore, we hypothesize the relationship between FDI and the extent of IIT to be ambiguous.

$DIST_{uat}$ is used as a proxy for the distance between Washington D.C. and a U.S. trading partner's capital city, measured in kilometers and reflecting transport costs. Ceteris paribus, as the distance increases, transportation cost also increases. Following Balassa (1966), we hypothesize that IIT is greater for trading partners who are geographically close. This is consistent with Hummels and Levinshon (1995); Leitão and Faustino (2008); and Shahbaz and Leitão (2010), who found a negative relationship between distance and the share of IIT. Therefore, the inverse relationship between distance and IIT share is our fifth hypothesis.

$EXRT_{uat}$ represents the real exchange rate in current USD between the U.S. and its trading partner. It is expected that the exchange rate might have both positive and negative effects on IIT. Rasekhi and Shojaee (2012) found a negative relationship between the exchange rate and IIT out of total trade. Oguro et al. (2008) analyzed the trade sensitivity to exchange rates in the presence of IIT and found an inverse relationship. In particular, a decline in the value of the local currency in terms of USD leads to higher IIT. In this thesis, we didn't predict any sign for this variable.

$R\&D_{at}$ represents research and development expenditures as a percentage of GDP in partner country a at time t , and it is used as proxy for the level of technological development of the U.S. trading partner. An increase in technological development is expected to enhance a country's capability to produce more differentiated products,

which would lead to more IIT. This relationship between R&D and IIT was observed by Gilroy and Broll (1988), who found a positive relationship. This was confirmed by Yuan (2012) who found similar results. Therefore, our seventh hypothesis is that an increase in investment in R&D is associated with an increase in the IIT share.

ARB_{at} denotes the available arable land in hectares in a partner country. It is used as proxy for factor endowment. A country with a large amount of fertile arable land is able to produce a large amount of products with high quality varieties, which ultimately leads to more IIT. In contrast, a country with unfertile arable land is unlikely to be able to produce enough products for trade and of a sufficient product quality of the product will be low. Rasekhi and Shojaee (2012) mentioned that countries with different endowments will produce different qualities of agricultural goods, so there is no certain sign about the relationship between ARB and the IIT share.

Following Łapinska (2014), V_{at} denotes the random error term at time t for country a . It has three components; e_t captures all observations in the time period t , u_a includes all the observations in the country a and ε_{at} includes only observations in the country a in time period t . The relationship between the random error and its components can be expressed as $V_{at} = e_t + u_a + \varepsilon_{at}$.

This chapter provides a description of the data, data sources, as well as the independent variables and their expected statistical relationships with a measure of IIT as dependent variable, summarized in Table 2. In the next chapter, we will discuss IIT trends and the analysis of IIT determinants.

Table 2: Summary of the variables (all variables expressed in logarithmic form)

Variable code	Description	Source
u, a, t	US, trade partner country, and time, respectively.	
B_{uat}	Dependent variable	UN Comtrade 2016
GDP_{at}	Economic size of the U.S. trading partner	World Bank 2016
$DGDPPCI_{uat}$	Relative difference in the U.S. and partner country a 's GDP per capita	World Bank 2016
$TIMB_{uat}$	Degree of trade imbalance between the U.S. and its trading partner	UN Comtrade 2016
FDI_{at}	Foreign direct investment inflow of partner country	World Bank 2016
$DIST_{uat}$	Distance between capital cities of the U.S. and its trading partner	CEPII
$EXRT_{uat}$	Real exchange rate in current USD between the U.S. and its trading partner	USDA 2016
$R\&D_{at}$	Research and development cost as a percentage of GDP in the partner country	World Bank 2016
ARB_{at}	Available arable land in partner country	World Bank 2016
V_{at}	Random error term	

Source: own composition.

Chapter 5: Results

5.1 IIT Trends for Selected Countries

Table 3 lists summary statistics pertaining to international trade for each country included in the analysis, including for total trade, the absolute amount of IIT, the G-L index, the total number of products traded, and the number of products traded that exhibit IIT between the U.S. and each partner country for products in the food and live animal industry between 2007 and 2014. A comparison of the summary statistics suggests there are considerable differences between the countries included in the study. While the relative importance of IIT increased, others exhibit mixed trends.

In terms of total trade in 2007 between the U.S. and its trading partners in the food and live animal industry, the top five countries were Canada, Mexico, Spain, Italy, and Germany with total trade of more than 29,753, 18,101, 1,875, 1,603, 1,561 million USD, respectively (Figure 1). This list remained the same in 2014, but the amount of total trade increased by a large margin. Canada, Mexico, Spain, Italy, and Germany traded more than 44,758, 32,406, 2,269, 2,574, and 2,658 million USD, respectively, with the U.S. for the products in the food and live animal industry. Among these five countries, Canada traded the largest number of products (132), followed by Mexico with 131 products in 2007 and both of them traded the same number of products in 2014. Spain, Italy, and Germany traded more products in 2014 than in 2007. Based on total trade between the U.S. and its trading partners in the food and live animal industry in 2007 and 2014, the bottom five positions were secured by Slovakia, Slovenia, Estonia, Cyprus, and

Table 3: Summary of the IIT share out of total trade in the food and live animal industry

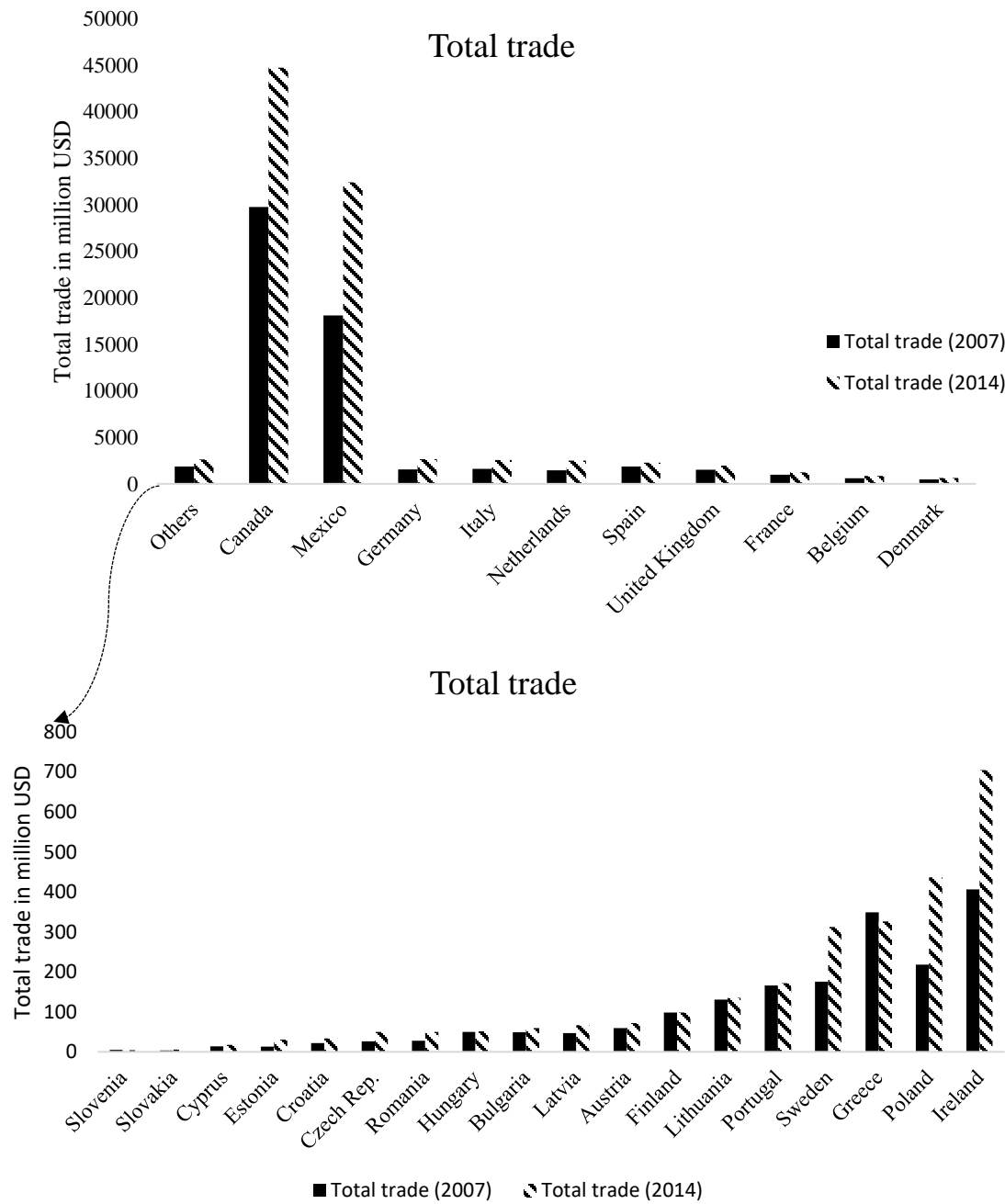
Partner	2007					2014				
	Total trade (mil. \$)	IIT (mil. \$)	IIT index	Total Prod- ucts (no.)	IIT Prod- ucts (no.)	Total trade (mil. \$)	IIT (mil. \$)	IIT index	Total Prod- ucts (no.)	IIT Prod- ucts (no.)
AT	59.30	47.22	0.23	55	20	72.04	54.34	0.16	53	18
BE	593.83	340.64	0.12	95	50	852.12	764.75	0.14	90	49
BG	49.13	27.51	0.07	35	11	59.07	38.67	0.12	51	18
CD	29,753.40	29,367.72	0.51	132	120	44758.41	44000.80	0.53	132	125
HR	21.54	7.81	0.36	45	9	33.44	11.17	0.08	45	8
CY	13.47	3.25	0.01	38	6	17.18	1.79	0.07	37	8
CZ	26.51	17.43	0.14	44	11	49.49	31.11	0.21	46	13
DK	487.89	304.89	0.11	90	37	634.88	518.18	0.06	87	42
EE	13.36	6.03	0.02	22	4	30.43	7.39	0.04	32	3
FI	98.07	66.18	0.09	52	12	98.25	36.88	0.08	50	10
FR	994.51	892.45	0.18	114	69	1243.81	1102.28	0.22	118	71
DE	1561.07	1385.01	0.14	115	68	2658.46	2547.14	0.09	116	76
EL	348.83	319.05	0.06	73	33	326.24	244.47	0.11	81	33
HU	49.67	26.69	0.11	45	14	51.37	43.64	0.18	44	15
IE	406.29	237.35	0.28	75	29	704.44	305.93	0.17	74	24
IT	1,603.86	944.27	0.13	111	64	2574.44	1886.75	0.15	112	68
LV	47.16	4.08	0.01	39	9	66.47	12.59	0.00	44	8
LT	130.57	17.16	0.01	46	10	135.19	26.81	0.02	56	10
MX	18,101.16	16,862.22	0.16	131	104	32406.39	29632.66	0.19	131	107
NL	1,437.99	1,291.65	0.16	115	74	2483.66	2250.68	0.14	120	78
PL	218.07	130.21	0.16	85	32	436.01	196.54	0.14	83	40
PT	165.67	90.21	0.05	79	30	171.90	75.84	0.08	75	25
RO	27.57	5.83	0.01	30	3	50.00	38.07	0.18	48	10
SK	3.71	0.04	0.00	16	1	5.45	2.15	0.03	17	4
SI	5.14	2.38	0.27	27	7	4.53	2.21	0.31	29	6
ES	1,875.28	1,051.86	0.07	107	57	2269.10	2026.45	0.11	110	71
SE	175.21	68.04	0.11	87	27	311.77	184.58	0.16	78	29
UK	1,511.22	1,303.79	0.20	119	66	1951.20	1890.04	0.31	117	78

Source: own composition.

Croatia, in descending order. In 2007, Slovakia traded only 16 products with a cash value of four million USD, and in 2014 both the number of total traded products and the cash value of total trade increased by a very small amount. Total trade also increased in the other four bottom-ranked countries in 2014 compared to 2007. In general, out of 28 selected trading partners, total trade increased for 26 countries and decreased for only two countries (Slovenia and Greece). Combining all selected countries together, in 2007 the U.S. traded more than 59 billion USD and in 2014 more than 94 billion USD with selected trading partners of the products in the food and live animal industry, representing an increase of almost 35 billion USD over the eight-year period.

Regarding the absolute amount of IIT between the U.S. and its trading partners in the food and live animal industry, the top two positions were also held by Canada and Mexico, but the third, fourth and fifth positions were held by Germany, the United Kingdom and the Netherlands, respectively. In 2007, Canada, Mexico, Germany, the United Kingdom and the Netherlands IIT comprised 29,368, 16,862, 1,385, 1,304, and 1,292 million USD, respectively, with the U.S. in the food and live animal industry. For Canada, 120 products out of the total number of products traded involved IIT. For Mexico, Germany, the United Kingdom and the Netherlands, 104, 68, 66, and 74 products showed IIT, respectively. In 2014, the fourth and fifth positions were occupied by the United Kingdom and Spain, but the top three positions continued to be held by Canada, Mexico, and Germany. For these five countries, the number of products involving IIT increased slightly, but the absolute amount of IIT increased by a large

Figure 1: Total trade volume in the food and live animal industry between the U.S. and selected partner countries



Source: own composition.

margin. In 2007, the bottom five countries based on their absolute amount of IIT were Slovakia, Slovenia, Cyprus, Latvia, and Romania, ranked from the lowest to the highest. By 2014, the five countries with the smallest absolute amount of IIT were Cyprus, Slovakia, Slovenia, Estonia and Croatia, in ascending order and only a few products for these countries exhibited IIT. Overall, out of the 28 partner countries, the absolute amount of IIT increased for 23 countries and decreased for 5 countries.

In 2007, the top five countries with the highest level of IIT index in the food and live animal industry were Canada, Croatia, Ireland, Slovenia, and Austria with IIT index values of 0.51, 0.36, 0.28, 0.27, and 0.23, respectively. At the industry level, Canada exhibited weak IIT, Croatia showed weak INT and remaining three countries displayed strong INT.⁹ Canada, Croatia, Ireland, Slovenia, and Austria had 25, 1, 4, 2, and 7 products with strong IIT, respectively. The same countries had 37, 3, 3, 2, and 1 product with weak IIT; 18, 0, 3, 1, and 5 products with weak INT and 40, 5, 19, 2, and 7 products with strong INT (Table 4). By 2014, the top five positions were held by Canada, UK, Slovenia, France, and the Czech Republic, respectively. Among these countries, Canada exhibited weak IIT, the UK and Slovenia showed weak INT and others showed strong INT in the food and live animal industry. Between 2007 and 2014, the IIT index increased for 19 of the 28 countries and decreased for nine countries.

⁹ Classification of IIT tendencies are explained in Section 4.1

Table 4: The number of products with IIT tendencies for trade between the U.S. and its trading partners for the food and live animal industry

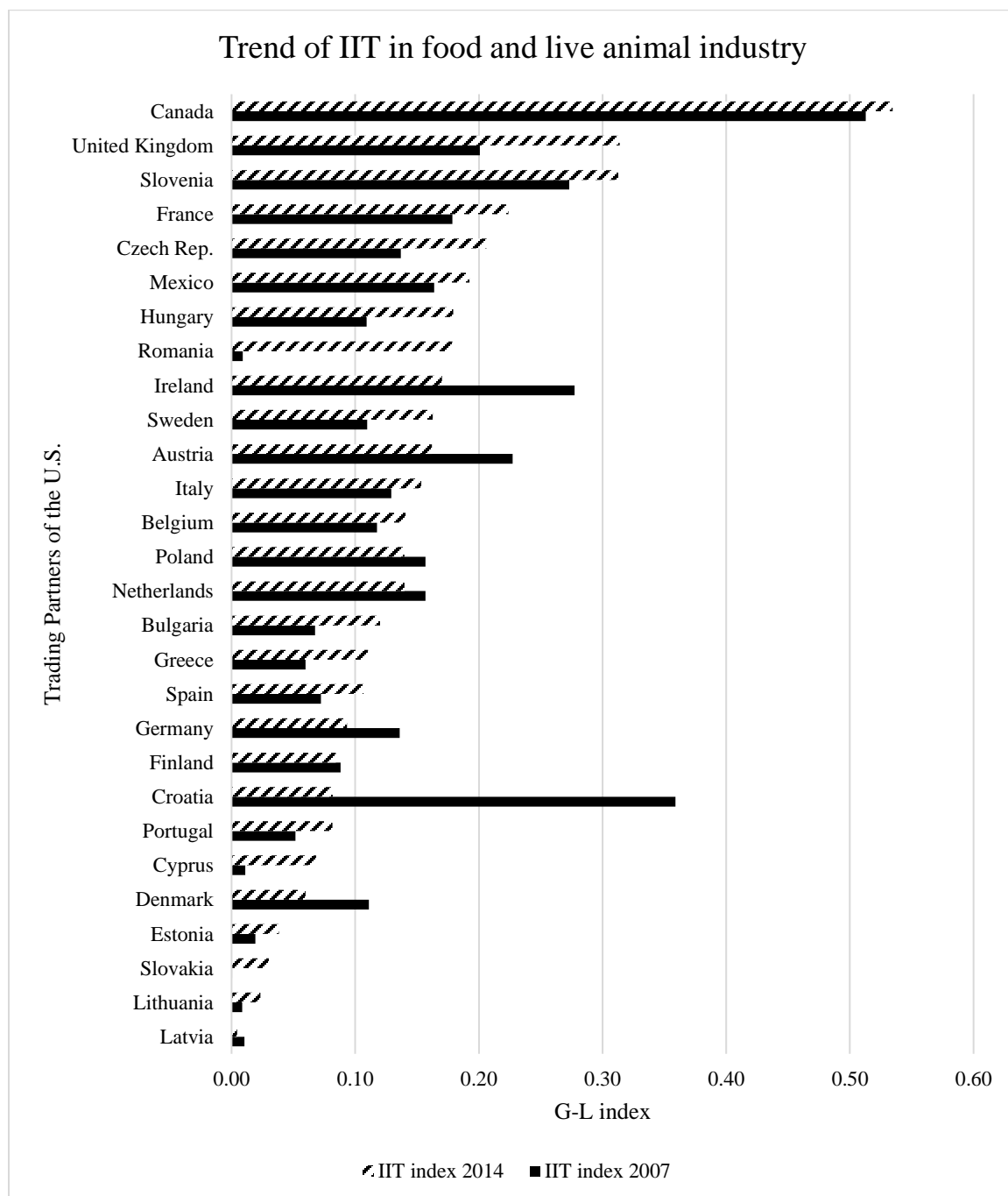
Partner	2007					2014				
	IIT Prod.	Strong IIT	Weak IIT	Weak INT	Strong INT	IIT Prod.	Strong IIT	Weak IIT	Weak INT	Strong INT
AT	20	7	1	5	7	18	1	4	5	8
BE	50	8	5	6	31	49	6	8	8	27
BG	11	2	1	2	6	18	2	2	6	8
CD	120	25	37	18	40	125	33	26	24	42
HR	9	1	3	0	5	8	0	3	0	5
CY	6	2	1	0	3	8	1	4	2	1
CZ	11	4	2	1	4	13	1	0	4	8
DK	37	4	7	6	20	42	5	4	9	24
EE	4	2	0	0	2	3	1	0	0	2
FI	12	1	1	3	7	10	2	0	3	5
FR	69	10	6	17	36	71	12	11	13	35
DE	68	9	9	17	33	76	8	13	8	47
EL	33	3	5	4	21	33	3	5	7	18
HU	14	3	1	2	8	15	0	5	2	8
IE	29	4	3	3	19	24	7	4	3	10
IT	64	8	11	10	35	68	3	4	14	47
LV	9	3	2	0	4	8	0	1	2	5
LT	10	4	0	2	4	10	1	2	3	4
MX	104	16	15	20	53	107	12	18	20	57
NL	74	9	10	19	36	78	9	8	14	47
PL	32	4	5	6	17	40	6	5	8	21
PT	30	6	3	6	15	25	3	7	5	10
RO	3	1	0	0	2	10	5	0	1	4
SK	1	0	0	0	1	4	0	0	0	4
SI	7	2	2	1	2	6	2	2	0	2
ES	57	7	7	12	31	71	10	11	10	40
SE	27	0	9	3	15	29	5	3	6	15
UK	66	8	12	11	35	78	9	16	16	37

Source: own composition.

Overall, in 2007 the countries conducting the largest amount of total trade with the U.S. were Canada with 29,753 million USD, and Mexico and Spain, respectively. Among the countries included in this study, the U.S. conducted the least amount of total trade with Slovakia. Canada also held the top position in terms of the absolute amount of IIT and Slovakia remained at the bottom of the list. These two positions remained the same in terms of the IIT index. At the industry level, only one of the 28 trading partners showed weak IIT tendencies, three countries showed weak INT tendencies and 24 countries showed strong INT tendencies.

In 2014, Canada remained at the top of the list in terms of total trade, and also in terms of the absolute amount of IIT with the U.S. among the selected trading partners included in this study, but the lowest-ranked countries were Slovenia, Cyprus and Latvia. Out of the 28 countries, the IIT index increased for 19 and decreased for 9 between 2007 and 2014 (Figure 2), but the IIT share out of total trade increased for 23 countries in 2014 compared to 2007 for the food and live animal industry. At the industry level, out of the 28 trading partners, only one country showed weak IIT tendencies, two countries had weak INT tendencies and 25 countries exhibited strong INT tendencies.

Figure 2: IIT indices for trade in the food and live animal industry between the U.S. and selected partner countries for 2007 and 2014



Source: own composition

5.2 Determinants

5.2.1 Model Selection

We used STATA 12.0 IC for our analysis. The three options for analyzing are to use pooled OLS / linear regression, a fixed effect model or a random effect model. A pooled regression approach would not allow for capturing the effects of changes over time, because the time variable would be considered as constant. In our dataset, all variables change over time for each nation except the distance variable, so using the pooled regression estimator technique would not be appropriate. Using a fixed effect model would result in the distance variable being omitted due to collinearity and so the results would become biased. This suggests that the most appropriate solution is to use a random effect model. We can verify whether our selected model is appropriate by using the method developed by Hausman (1978), known as Hausman test which tests for the best model between the fixed effect and random effect models. The null hypothesis for this test is that the random effect model is appropriate and the alternative hypothesis is fixed effect model is appropriate. This test analyzes whether the errors are correlated with the regressors or not. This test has an asymptotic Chi-Square distribution with $(k-1)$ degrees of freedom, where k equals the number of regressors.

Results of the Hausman test listed in Table 5 indicate that the probability is 0.15 which is greater than 0.05, suggesting that we cannot reject the null hypothesis. In other words, there is no correlation between error terms and the explanatory variables, so using the fixed effect model would create biased and inconstant estimators, whereas the random

effect model will provide unbiased and consistent results. Hence, the random effect model is more appropriate than the fixed effect model for our analysis.

Table 5: Hausman test results

	Fixed effect	Random effect	Difference	S.E.
GDP	2.23	0.88	1.25	0.77
DGDPPC	5.84	3.41	2.43	3.20
TIMB	-0.89	-0.12	0.04	0.02
FDI	-0.02	-0.03	0.01	0.01
EXRT	-0.003	0.01	-0.01	0.02
R&D	0.60	0.48	0.12	0.20
ARB	0.18	-0.70	0.89	1.24
$\chi^2(6) = 10.75$	Probability $> \chi^2 = 0.15$			

Breusch and Pagan (1980) developed a test to analyze the random effects on the basis of OLS residuals, which is known as Breusch-Pagan Lagrange Multiplier test (B-P test). This test is used to select the most appropriate model among the random effect model and simple/pooled regression model. The null hypothesis is there is no necessity to control the random term. In other words, having zero variances across entities would indicate having no panel effect, in which case a simple regression model would be appropriate. The alternative hypothesis is the variances would be non-zero, so the random effect model would be appropriate.

The B-P test results listed in Table 6 indicate that variances are not zero, which suggests that there is heterogeneity between the countries in the sample. The probability

value is also less than 5% and significant. For these reasons, we reject the null hypothesis and conclude that the random effect model is more appropriate than the simple linear regression model.

Table 6: Result of the Breusch-Pagan Lagrange Multiplier test for random effects

	Var	Sd= sqrt (Var)
Bi	1.98	1.41
e	0.38	0.61
u	0.67	0.81

Test: Var (u) = 0
 $\bar{\chi}^2 (01) = 218.55$
 Prob > $\bar{\chi}^2 = 0.00$

The existence of serial correlation in the panel data bias the standard error and may lead to inefficient results.¹⁰ To check the existence of serial correlation we ran the Pecaran CD (cross-sectional dependence) test with a null hypothesis of no serial correlation and the alternative hypothesis that serial correlation is present. This test is used to analyze whether the residuals are correlated across entities. The result of Pesaran test shows a probability value of 1.37 which is very high and exceeding the critical value of 0.05, meaning that the result is statistically insignificant. Therefore, we fail to reject the null hypothesis and end up with no existence of serial correlation among the independent variables.

¹⁰ Correlation of the error terms for different time periods is called serial correlation or autocorrelation.

5.2.2 Result of the Random Effect Model

Leamer (1994) suggested checking the simple correlation matrix between dependent and independent variables in the regression analysis as it can be quite difficult to interpret the partial correlations that emerge from the regression analysis. The results of the simple correlation matrix are listed in Table 7. The values of correlations are divided into 2 groups. Values between 0 to 0.5 are deemed to exhibit a weak correlation and values between 0.51 and 1 are considered exhibiting strong correlations among the variables. The lowest possible value of a correlation coefficient is zero, meaning that there is no correlation between the variables and its highest value is one indicating there is perfect correlation between the variables and its highest value is one indicating there is perfect correlation between two variables. Table 7 shows that the dependent variable *Bi* has a weakly positive correlation with GDP, FDI, EXRT, R&D, and ARB and is weakly negative correlated with DGDPPC, TIMB and DIST.

Table 7: Correlation matrix between the dependent and the independent variables

	Bi	GDP	DGDPPC	TIMB	FDI	DIST	EXRT	R&D	ARB
Bi	1.00								
GDP	0.50	1.00							
DGDPPC	-0.36	-0.48	1.00						
TIMB	-0.31	-0.24	0.17	1.00					
FDI	0.40	0.66	-0.38	-0.09	1.00				
DIST	-0.41	-0.39	0.14	0.06	-0.33	1.00			
EXRT	0.15	-0.09	0.20	0.17	0.05	0.06	1.00		
R&D	0.39	0.37	-0.67	-0.07	0.21	-0.08	-0.07	1.00	
ARB	0.26	0.72	0.11	-0.15	0.37	-0.51	0.09	0.01	1.00

Results of applying the GLS random effect model in STATA 12.0 IC show that the model is statistically significant with a probability of 0.00, less than the initial value of 5%. The panel data set is strongly balanced, i.e., there are no missing values for any of the observations. There are 224 observations in 28 groups, where each group represents a trading partner of the U.S. The results show that differences across units are uncorrelated with the regressors. Intra-class correlation, denoted by the Rho value is 0.64, meaning that 64% of the variance is due to differences across panels.

$$\text{Rho} = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2},$$

where σ_u^2 is the variance of residuals within groups u and σ_e^2 denotes variance of residuals (overall error term) e .¹¹

The logarithmic value of each variable is used in this analysis, and we performed a logistic transformation of the dependent variable which is $(\beta_{uat}/(1 - \beta_{uat}))$, where β_{uat} is IIT and $1 - \beta_{uat}$ is INT. In other words, ceteris paribus a one percent increase in the explanatory variable causes a change in the dependent variable by a magnitude indicated by the parameter value.

¹¹ e captures all observations in time period t , u includes all observations in country a , and ε captures affecting only observations in the country a , in the time period t . Random error $V = e + u + \varepsilon$.

Table 8: Results of the estimation of the GLS random effect model

Dependent Variable= $B_{uat} = \ln(\beta_{uat}/(1 - \beta_{uat}))$					
Explanatory variables	Coefficient	Std. Error	Z	p> z	Significance
GDP	0.88	0.25	3.57	0.00	***
DGDPPC	3.41	1.81	1.89	0.06	*
TIMB	-0.12	0.06	-2.24	0.03	**
FDI	-0.03	0.04	-0.73	0.47	
DIST	-1.39	0.43	-3.22	0.00	***
EXRT	0.01	0.00	2.46	0.01	**
R&D	0.48	0.17	2.79	0.01	***
ARB	-0.70	0.25	-2.78	0.01	***
_cons	-3.57	5.68	-0.63	0.53	

Note: *, **,*** denote statistical significant at the level of 10%, 5%, and 1%, respectively.

The results listed in Table 8 indicate that the coefficient for *GDP* is positive and statistically significant at the one percent level, suggesting that *GDP* has a positive relationship with the logistic transformation of dependent variable ($\beta_{uat}/(1 - \beta_{uat})$). More specifically, a one percent increase in a partner country's *GDP* causes 0.88% increase in IIT intensity relative to INT. This result confirms Hypothesis 1, that is, there is a positive relationship between a trading partner's economic size and IIT intensity.

The independent variable *DGDPPC*, representing the relative difference in economic development, is statistically significant at the ten percent confidence level. Most previous empirical studies found a negative relationship between the IIT share and the relative difference in GDP per capita. The simple logic about this relationship is that a

relative large difference in GDP per capita corresponds with a low per capita GDP and ultimately a low level of economic development for the trading partner. As a result, consumers in a partner country will show less interest toward differentiated products. However, in contrast to previous findings and expectations, our analysis shows a *DGDPPC* coefficient of 3.41 which is positive and statistically significant at the ten percent level. Therefore, the Hypothesis of a negative correlation between the relative difference in income per capita (*DGDPPC*) between the U.S. and its trading partner and the IIT intensity remains unverified.

Variable *TIMB* denotes the relative trade imbalance between the U.S. and its trading partners. Imbalanced trade normally attracts INT, so an increase in the relative trade imbalance would be associated with a decrease in IIT intensity. The regression results show the coefficient for *TIMB* is negative as expected, and it is statistically significant at the five percent level. The general implication of this finding is that a one percent increase in the relative trade imbalance causes a 0.12 percent decrease in the IIT to INT ratio, so Hypothesis 3 is positively verified.

FDI represents the foreign direct investment inflow into partner countries (in current USD). An inflow of cash will lead to a temporary financial solvency in recipient countries, which enables the consumers of those countries to buy additional differentiated products. However, because it is a temporary cash inflow, the FDI inflow might have an inverse effect as well and therefore the predicted sign for this variable was indeterminate. The results of regression analysis indicate that the *FDI* coefficient is -0.03 which

indicates a negative relationship with the logistic transformation of IIT, but the parameter estimate is statistically insignificant.

DIST denotes the distance between Washington D.C. and capital cities of the U.S. trading partners, which is generally considered to be an important determinant for both IIT and INT. Trade between neighboring countries tends to be large because distance is directly related to transportation cost. As a result, nations located far from one another face high transportation costs which will lead to reduced trade. The Gravity theory of trade also supports this statement and suggests there will be a relatively high level of trade between countries that share a common border. The results of regression analysis indicate that the distance coefficient is -1.39, indicating a negative relationship between distance and the IIT share, and it is statistically significant at the one percent level. The interpretation of the result is that a one percent increase in the geographical distance between two trading partner results in a 1.39% decrease in IIT intensity relative to INT. These results are consistent with expectations, thus verifying Hypothesis 5.

The variable *EXRT* measures the real exchange rate between the U.S. and its trading partners in current USD. The exchange rate can have both a positive and a negative effect on IIT. In general, an increase in the real value of the U.S. dollar would be expected to increase net imports by the United States and decrease its net exports. Therefore, the predicted sign for this variable is indeterminate. The regression results show that the *EXRT* coefficient is 0.01 which is significant at the five percent level and positively correlated with the IIT to INT ratio. The interpretation of this result is that a

one percent increase in *EXRT* results in a 0.01 percent increase in IIT intensity relative to INT, thus confirming Hypothesis 6.

R&D represents the cost of research and development as a percentage of a partner country's GDP, and is used as proxy for the level of technological development of the U.S. trading partner. An increase in technological development would be expected to enhance a country's capability to produce more differentiated products which would lead to additional IIT. The results indicate the *R&D* parameter estimate is positive and statistically significant at the one percent level. This confirms Hypothesis 7, which states that an increase in *R&D* investment is associated with an increase in the IIT intensity relative to INT.

ARB denotes the amount of available arable land of partner countries in hectares, and is used as proxy for factor endowment. A partner country with large amount of fertile arable land may have more agricultural trade because large arable land holding would allow a country to produce a large number of products and fertile land helps to produce high quality varieties, which ultimately leads to additional IIT. In contrast, if the land is not fertile, then the country would not be able to produce enough products for trade and the quality of the product would be low. However, even having a large amount of arable land may negatively affect IIT. So, the *ARB* variable can have a mixed effect on IIT intensity. The regression results show a negative relationship between *ARB* and IIT to INT ratio, with a statistically significant estimate at the one percent level, thus confirming Hypothesis 8.

5.3 Limitations and Suggestions for Further Research:

This study provides an analysis of IIT within the food and live animal industry for SITC revision 4 with a product classification at the 4-digit level. The highest level of detail of product differentiation is provided at the 5-digit level in the SITC revision 4 system. In general, the degree of IIT increases as the degree of aggregation increases as well, so the highest IIT value would be obtained at the one-digit level and the lowest IIT value would be expected at the 5-digit level for a particular industry. In other word, the degree of disaggregation is highest at the 5-digit level, which also enables an in-depth analysis of IIT.

This study is subject to a number of limitations. The results of this study were limited by the chosen research method, availability of data and by time restrictions. In this thesis, we only consider country-specific determinants of IIT. Future research could focus on analyzing both country-specific and industry-specific determinants, in the effort to obtain more accurate information about the determinants of IIT.

One of our expectations was to relate value-added agriculture with IIT because both deal with differentiated products. While a number of earlier studies used value-added agriculture as a percentage of GDP as a determinant of IIT, we were unable to do so because data pertaining to this variable are not available on the world bank database (2016) for all selected years. Lack of available data was also the reason for dropping Malta and Luxemburg from our initial sample size of 30 nations.

An additional caveat of the study's result is the large importance of Canada and Mexico in the U.S. trade relationship in comparison the EU member nations. Trade between the U.S. and Canada and the U.S. and Mexico contributed more than 80% of total trade in the food and live animal industry among the selected trading partners included in this study. As a result of the large dominance of Canada and Mexico, the impact of the remaining 26 European countries on our final results was relatively low.

Chapter 6: Conclusions and Implications

Two-way trade or IIT plays an important role in the trade relationship between the U.S. and its European and NAFTA trading partners. This is also true for the food and live animal industry, even though the IIT indices for most of these trading partners was very low, however, they showed increasing trends for most of the trading partners selected for this study between 2007 and 2014. In this study, we identify IIT trends in the food and live animal industry for selected countries and analyze country-specific determinants of IIT. Gaining an understanding of the determinant of IIT is important because, first, studying IIT may provide information not observable when analyzing INT only, as IIT deals with differentiated products while INT deals with different products only. Second, the presence of IIT may provide an indication of the existence of imperfect competition in the industry. The results indicate that IIT increased for 19 of the 28 U.S. partner countries studied between 2007 and 2014. Increase in IIT is seen as a positive development for a country, because increase in IIT normally related to the increase in differentiated products. As a result, local consumers get more options to choose from and more domestic resources are used in the production of this products which ultimately leads to additional employment opportunities and increase in GDP.

The analysis of the IIT determinants indicates that the size of a nation's economy, difference in level of economic development, the real exchange rate, and a partner country's level of technological development each has a positive impact on IIT. On the other hand, the existence of a trade imbalance, geographical distance, and available arable land each has a negative impact on IIT. Results of this study confirm that the

impact of almost all of the identified determinants of intra-industry trade is consistent with the predictions of the theory and the findings of previous empirical studies.

The increasing trend in IIT reflects the growing demand for differentiated products, which in turn reflects the increased importance of the role that value-added agriculture plays in modern agriculture. Though this study does not directly address the relationship between the IIT share and value-added agriculture, it stands to the reason that value-added agriculture has an international counterpart and is positively related to IIT. As value-added agriculture is becoming increasingly important, future studies may be able to incorporate it explicitly in explaining IIT.

Another important finding of this study is the positive relationship between the IIT share and R&D. Generally, profit margins tend to be higher for high-end products than for raw commodities. By increasing its R&D investments, a country may be able to advance technologically which would be expected to increase the number of varieties of product. This could also lead to further specialization and additional INT and IIT. Thus, one of the policy implications is support for R&D may help achieve higher levels of IIT and therefore higher profitability levels.

References

- Anishchenko, Y. (2013). "Intra-industry Trade: The Case of European Union's Agri-food sector." Doctoral Thesis, Università degli Studi di Udine.
- Aturupane, C., Djankov, S., & Hoekman, B. (1997). "Determinants of Intra-industry trade between East and West Europe". *CEPR Discussion Paper 1721, London*.
- Balassa, B. (1966). "Tariff Reductions and Trade in Manufacturers Among the Industrial Countries." *The American Economic Review*, 56(3), 466-473.
- Balassa, B., & Bauwens, L. (1987). "Intra-Industry Specialisation in a Multi-Country and Multi-Industry Framework." *The Economic Journal*, 97(388), 923-939.
- Balassa, B., & L. Bauwens (1988). "The Determinants of Intra-European Trade in Manufactured Goods." *European Economic Review* 32(7), 1421-1437.
- Botrić, V. (2013). "Determinants of Intra-Industry Trade between Western Balkans and EU-15: Evidence from Bilateral Data." *International Journal of Economic Sciences and Applied Research*, 2, 7-23.
- Brühlhart, M. (1994). "Marginal Intra-industry Trade: Measurement and Relevance for the Pattern of Industrial Adjustment." *Review of World Economics*, 130(3), 600-613.
- Brühlhart, M. & Mathys, N.A. (2008). "Sectoral Agglomeration Economies in a Panel of European Regions." *Regional Science and Urban Economics, Elsevier*, 38(4), 348-362.
- Breusch, T. & Pagan, A. (1980). "The LaGrange Multiplier Test and Its Application to Model Specification in Econometrics." *Review of Economic Studies*, 47(1), 239-254.

- Clark, D. P., & Stanley, D. L. (1999). "Determinants of Intra-industry Trade between Developing Countries and the United States." *Journal of Economic Development*, 24(2), 79-95.
- Crespo, N., & Fontoura, M. P. (2004). "Intra-industry Trade by Types: What can We Learn from Portuguese Data?" *Review of World Economics*, 140(1), 52-79.
- Davis, D. R. (1995). "Intra-industry Trade: a Heckscher-Ohlin-Ricardo Approach." *Journal of International Economics*, 39(3), 201-226.
- Dautovic, E., Orszaghova, L., & Schudel, W. (2014). "Intra-industry Trade between CESEE Countries and the EU15." *European Central Bank Working Paper Series*, No. 1719, August.
- Eaton, J., & Kierzkowski, H. (1984). "Oligopolistic Competition, Product Variety, Entry Deterrence, and Technology Transfer." *The RAND Journal of Economics*, 15, 99-107.
- Ekanayake, E. M., Halkides, M., Rance, R., Rance, R., & Filyanova, I. (2007). "Intra-Industry Trade between the United States and Latin American Countries." *The International Journal of Business and Finance Research*, 1(2), 109-124.
- Falvey, R. E. (1981). "Commercial Policy and Intra-industry trade." *Journal of International Economics*, 11(4), 495-511.
- Falvey, R. E., & Kierzkowski, H. (1987). "Product Quality, Intra-industry Trade and Perfect Competition in International Trade." *Essays in Honor of W. M. Corden*, Macmillan, Oxford.

- Fertő, I. (2007). "Intra-industry Trade in Horizontally and Vertically Differentiated Agri-food Products between Hungary and the EU." *Acta Oeconomica*, 57(2), 191-208.
- Fertő, I., & Jambor, A. (2015). "Drivers of Vertical Intra-industry Trade: the Vase of the Hungarian Agri-food Sector." *Agricultural Economics*, 46(1), 113-123.
- de Frahan, B. H., & Tharakan, J. (1998). "Horizontal and Vertical Intra-industry trade in the Processed Food Sector." *American journal of Agricultural Economics*, 80(5), 1177.
- Faustino H. & Leitão N. C. (2007), "Country-Specific Determinants of Intra-industry Trade in Portugal." Working Paper No. 27, ISSN No 0874-4548, Department of Economics at the School of Economics and Management, Technical University of Lisbon.
- Finger, J. M. (1975). "Trade Overlap and Intra-industry Trade." *Economic inquiry*, 13(4), 581-589.
- Gilroy, B.M. & Broll, U. (1988): "Intra-Industry Trade and Differences in Technology." *Scottish Journal of Political Economy*, 35(4), 398-403.
- Greenaway, D., & Milner, C. (1983). "On the Measurement of Intra-Industry Trade." *The Economic Journal*, 93(372), 900-908.
- Greenaway, D., Milner, D., & David Greenaway, D. M. (1986). "The Economics of Intra-industry Trade." Oxford: Basil Blackwell.
- Greenaway, D., Hine, R., & Milner, C. (1994). "Country-specific Factors and the Pattern of Horizontal and Vertical intra-industry Trade in the UK." *Weltwirtschaftliches Archiv*, 130(1), 77-100.

- Grubel, H.G., & Lloyd, P.J. (1975). "Intra-industry Trade." *London: MacMillan Press*.
- Hamilton, C., & Kniest, P. (1991). "Trade Liberalisation, Structural Adjustment and Intra-industry trade: a Note." *Weltwirtschaftliches Archiv*, 127(2), 356-367.
- Hart, T. & McDonald, B. J. (1992). "Intra-Industry Trade Indexes for Canada, Mexico, and the United States 1962-87," Staff Report No. AGES 9206, Agricultural and Trade Analysis Division, Economic Research Service, U.S. Department of Agriculture.
- Hausman, J. A. (1978). "Specification Tests in Econometrics." *Econometrica: Journal of the Econometric Society*, 46, 1251-1271.
- Helpman, E., & Krugman, P. R. (1985). "Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy." *MIT press*.
- Hummels, D. & Levinsohn, J. (1995). "Monopolistic Competition and International Trade: Reconsidering the Evidence." *Quarterly Journal of Economics*, (110)3, 799-836.
- Jámbor, A. (2015). "Country-and Industry-specific Determinants of Intra-industry Trade in Agri-food Products in the Visegrad countries." *Studies in Agricultural Economics* 117(2), 93-101.
- Jámbor, A. (2014) "Country-Specific Determinants of Horizontal and Vertical Intra-industry Agri-food Trade: The Case of the EU New Member States." *Journal of Agricultural Economics* 65 (3), 663-682.

- Jing, W., Leitão, N. C., & Faustino, H. C. (2010). "Intra-industry Trade in Agricultural Products: the Case of China." *Instituto Superior de Economia e Gestão. DE Working papers*; no. 6-2010/DE/SOCIUS
- Krugman, P. (1979). "Increasing Returns, Monopolistic Competition and International Trade." *Journal of International Economics*, 9(4), 469–479.
- Krugman, P. R., & Obstfeld, M. (1991). "International Economics: Theory and Policy (Second ed.)." *New York: Harper Collins*.
- Łapinska, J. (2014). "Determinants of Intra-Industry Trade in Agricultural and Food Products between Poland and EU Countries." *Danube*, 5(3), 159-172.
- Lancaster, K. (1980). "Intra-industry Trade Under Perfect Monopolistic Competition." *Journal of International Economics*, 10(2), 151–176.
- Lee, H.-H., & Lee, Y.-Y. (1993). "Intra-Industry Trade in Manufactures: The Case of Korea." *Weltwirtschaftliches Archiv*, 129(1), 159–171.
- Leitão, N.C. (2011). "Intra-industry Trade in the Agriculture Sector: The Experience of United States." *African Journal of Agricultural Research*, 6(1), 186–190
- Leitão, N. C., & Faustino, H. (2008). "Intra-industry Trade in the Food Processing Sector: The Portuguese Case." *Journal of Global Business and Technology*, 4(1), 49-58.
- Leitão, N. C., & Faustino, H. (2009). "Intra-industry Trade in the Automobile components industry: An Empirical analysis." *Journal of Global Business and Technology*, 5(1), 31-41.

- Leamer, E. (1994). "Testing Trade Theories," in D. Greenaway and L. Alan Winters (ed.). *Surveys in International Trade*. Oxford: Blackwell.
- Luka, O., & Levkovych, I. (2004). "Intra-industry Trade in Agricultural and Food products: The Case of Ukraine (No. 78)." Discussion paper//Institute of Agricultural Development in Central and Eastern Europe.
- Manrique, G. C. (1987). "Intra-Industry Trade between Developed and Developing Countries: The United States and the NICs." *The Journal of Developing Areas*, 21(4), 481-494.
- Michaely, M. (1962). "Multilateral Balancing in International Trade." *American Economic Review*, 52, 685-702.
- Oguro, Y., Fukao, K., & Khatri, M. Y. (2008). "Trade Sensitivity to Exchange rates in the Context of Intra-industry Trade (No. 8-134). *International Monetary Fund*.
- Qasmi, B. A., & Fausti, S. W. (2001). "NAFTA Intra-industry Trade in Agricultural Food Products." *Agribusiness*, 17(2), 255-271.
- Rasekhi, S., & Shojaee, S. S. (2012). "Determinant Factors of the Vertical Intra-industry Trade in Agricultural Sector: A Study of Iran and Its Main Trading Partners." *Agricultural Economics / Zemedelska Ekonomika*, 58(4), 180-190.
- Richardson, J. D. (1988). "Empirical Research on Trade Liberalisation with Imperfect Competition: A Survey," OECD Economics Department Working Papers, No. 58, OECD Publishing
- Sazanami, Y., & Hamaguchi, N. (1978). "Intra-Industry Trade in EEC; 1962-1972." *Keio Economic Studies*, 15(2), 53-68.

- Sichei, M. M., Harmse, C., & Kanfer, F. (2007). "Determinants of South Africa-U.S. Intra-industry Trade in Services: A Wild Bootstrap Dynamic Panel Data Analysis." *South African Journal of Economics*, 75(3), 521-539.
- Shahbaz, M., & Leitão, N. C. (2010). "Intra-industry Trade: The Pakistan Experience." *International Journal of Applied Economics*, 7(1), 18-27.
- Thorpe, M. W., & Leitão, N. C. (2013). "Determinants of United States' Vertical and Horizontal Intra-Industry Trade." *Global Economy Journal*, 13(2), 233-250.
- Türkcan, K. (2005). "Determinants of intra-industry trade in final goods and intermediate goods between Turkey and selected OECD countries." *Istanbul University Econometrics and Statistics e-Journal*, 1(1), 21-40.
- Verdoorn, P. (1960). "The Intra-bloc Trade of Benelux. In Robinson, E. (Ed.)." *Economic Consequences of the Size of Nations*. Macmillan, London, 291-329.
- Varma, P. (2011). "An Analysis of India's Bilateral Intra-industry Trade in Agricultural Products." *International Journal of Economics and Business Research*, 4(1-2), 83-95.
- Varma, P., & Ramakrishnan, A. (2014). "An Analysis of the Structure and the Determinants of Intra-Industry Trade in Agri-food Products: Case of India and Selected FTAs." *Millennial Asia*, 5(2), 179-196.
- Vona, S. (1991). "On the Measurement of Intra-industry Trade: Some Further Thoughts." *Weltwirtschaftliches Archiv*, 127(4), 678-700.

Wang, J. (2009). "The Analysis of Intra-industry Trade on Agricultural Products of China." *Frontiers of Economics in China*, 4(1), 62-75.

Yuan, L. (2012). "Intra-industry Trade Between Sweden and Middle Income Countries." Student Thesis- Industrial Economics and Management (Dept.), KTH URN: urn:nbn:se:kth:diva-98301

Zhang, Z., & Li, C. (2006). "Country-Specific Factors and the Pattern of Intra-Industry Trade in China's Manufacturing." *Journal of International Development*, 18, 1137–1149.

Appendix

List of SITC revision 4 commodities at 4-digit level for the food and live animal industry-

001.1 - Bovine animals, live

001.2 - Sheep and goats, live

001.3 - Swine, live

001.4 - Poultry, live (i.e., fowls of the species *Gallus domesticus*, ducks, geese, turkeys and guinea-fowls)

001.5 - Horses, asses, mules and hinnies, live

001.9 - Live animals, n.e.s.

011.1 - Meat of bovine animals, fresh or chilled

011.2 - Meat of bovine animals, frozen

022.1 - Milk (including skimmed milk) and cream, not concentrated or sweetened

022.2 - Milk and cream, concentrated or sweetened

022.3 - Yogurt; buttermilk, curdled, fermented or acidified milk and cream; ice-cream

022.4 - Whey; products consisting of natural milk constituents, n.e.s.

023.0 - Butter and other fats and oils derived from milk; dairy spreads

024.1 - Grated or powdered cheese, of all kinds

024.2 - Processed cheese, not grated or powdered

024.3 - Blue-veined cheese and other cheese containing veins produced by *Penicillium roqueforti*

024.9 - Other cheese; curd

025.1 - Birds' eggs, in shell, fresh, preserved or cooked

- 025.2 - Birds' eggs, not in shell, and egg yolks
- 025.3 - Egg albumin
- 034.1 - Fish, fresh (live or dead) or chilled (excluding fillets and minced fish)
- 034.2 - Fish, frozen (excluding fillets and minced fish)
- 034.4 - Fish fillets, frozen
- 034.5 - Fish fillets, fresh or chilled, and other fish meat (whether or not minced), fresh, chilled or frozen
- 035.1 - Fish, dried, salted or in brine, but not smoked
- 035.2 - Fish, salted but not dried or smoked and fish in brine
- 035.3 - Fish (including fillets), smoked, whether or not cooked before or during the smoking process.
- 035.4 - Fish liver and roes, dried, smoked, salted or in brine
- 035.5 - Flours, meals and pellets of fish, fit for human consumption
- 036.1 - Crustaceans, frozen
- 036.2 - Crustaceans, other than frozen, including flours, meals and pellets of crustaceans, fit for human consumption
- 036.3 - Molluscs and aquatic invertebrates, fresh, chilled, frozen, dried, salted or in brine; flours, meals and pellets of aquatic invertebrates other than crustaceans, fit for human consumption
- 037.1 - Fish, prepared or preserved, n.e.s.; caviar and caviar substitutes prepared from fish eggs.
- 037.2 - Crustaceans, molluscs and other aquatic invertebrates, prepared or preserved, n.e.s.
- 041.1 - Durum wheat, unmilled
- 041.2 - Other wheat (including spelt) and meslin, unmilled

- 042.1 - Rice in the husk (paddy or rough rice)
- 042.2 - Rice, husked but not further prepared (cargo rice or brown rice)
- 042.3 - Rice, semi-milled or wholly milled, whether or not polished, glazed, parboiled or converted (including broken rice)
- 043.0 - Barley, unmilled
- 044.1 - Seed
- 044.9 - Other
- 045.1 - Rye, unmilled
- 045.2 - Oats, unmilled
- 045.3 - Grain sorghum, unmilled
- 045.9 - Buckwheat, millet and canary seed; other cereals, unmilled, n.e.s.
- 046.1 - Flour of wheat or of meslin
- 046.2 - Groats and meal of wheat
- 047.1 - Cereal flours (other than of wheat or meslin)
- 047.2 - Cereal groats, meal and pellets, n.e.s.
- 048.1 - Cereal grains, worked or prepared in a manner not elsewhere specified (including prepared breakfast foods)
- 048.2 - Malt, whether or not roasted (including malt flour)
- 048.3 - Macaroni, spaghetti and similar products (pasta), uncooked, not stuffed or otherwise prepared
- 048.4 - Bread, pastry, cakes, biscuits and other bakers' wares, whether or not containing cocoa in any proportion; communion wafers, empty cachets of a kind suitable for pharmaceutical use, sealing wafers, rice-paper and similar products.
- 048.5 - Mixes and doughs for the preparation of bakers' wares of subgroup 048.4

- 054.1 - Potatoes, fresh or chilled (not including sweet potatoes)
- 054.2 - Leguminous vegetables, dried, shelled, whether or not skinned or split.
- 054.4 - Tomatoes, fresh or chilled
- 054.5 - Other fresh or chilled vegetables
- 054.6 - Vegetables (uncooked or cooked by steaming or boiling in water), frozen
- 054.7 - Vegetables provisionally preserved (e.g., by sulphur dioxide gas, in brine, in sulphur water or in other preservative solutions), but unsuitable in that state for immediate consumption
- 054.8 - Vegetable products, roots and tubers, chiefly for human food, n.e.s., fresh, dried or chilled
- 056.1 - Vegetables, dried (excluding leguminous vegetables), whole, cut, sliced, broken or in powder, but not further prepared
- 056.4 - Flour, meal, flakes, granules and pellets of potatoes, fruits and vegetables, n.e.s.
- 056.6 - Vegetables prepared or preserved otherwise than by vinegar or acetic acid, n.e.s., frozen
- 056.7 - Vegetables, prepared or preserved, n.e.s.
- 057.1 - Oranges, mandarins, clementines and similar citrus hybrids, fresh or dried
- 057.2 - Other citrus fruit, fresh or dried
- 057.3 - Bananas (including plantains), fresh or dried
- 057.4 - Apples, fresh
- 057.5 - Grapes, fresh or dried
- 057.6 - Figs, fresh or dried
- 057.7 - Edible nuts (excluding nuts chiefly used for the extraction of oil), fresh or dried, whether or not shelled or peeled

- 057.9 - Fruit, fresh or dried, n.e.s.
- 058.1 - Jams, fruit jellies, marmalades, fruit or nut purée and fruit or nut pastes, being cooked preparations, whether or not containing added sugar or other sweetening matter, not including homogenized preparations
- 058.2 - Fruit and nuts, provisionally preserved; peel of citrus fruit or melons
- 058.3 - Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter
- 058.9 - Fruit, nuts and other edible parts of plants otherwise prepared or preserved, whether or not containing added sugar or other sweetening matter or spirit, n.e.s.
- 059.1 - Orange juice
- 059.2 - Grapefruit juice
- 059.3 - Juice of any other single citrus fruit
- 059.9 - Juice of any single fruit (other than citrus) or vegetable; mixtures of fruit or vegetable juices
- 061.1 - Sugars, beet or cane, raw, in solid form, not containing added flavouring or colouring matter
- 061.2 - Other beet or cane sugar and chemically pure sucrose, in solid form
- 061.5 - Molasses resulting from the extraction or refining of sugar
- 061.6 - Natural honey
- 061.9 - Other sugars (including chemically pure lactose, maltose, glucose and fructose in solid form); sugar syrups not containing added flavouring or colouring matter; artificial honey (whether or not mixed with natural honey); caramel
- 062.1 - Vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glaze or crystallised)
- 062.2 - Sugar confectionery (including white chocolate), not containing cocoa
- 071.1 - Coffee, not roasted, whether or not decaffeinated

071.2 - Coffee, roasted

071.3 - Extracts, essences and concentrates of coffee and preparations with a basis of these products or with a basis of coffee; coffee substitutes and extracts, essences and concentrates thereof

072.1 - Cocoa beans, whole or broken, raw or roasted

072.2 - Cocoa powder not containing added sugar or other sweetening matter

072.3 - Cocoa paste, whether or not defatted

072.4 - Cocoa butter, fat and oil

072.5 - Cocoa shells, husks, skins and other cocoa waste

073.1 - Cocoa powder containing added sugar or other sweetening matter

073.2 - Other food preparations containing cocoa, in blocks, slabs or bars weighing more than 2 kg or in liquid, paste, powder, granular or other bulk form in containers or immediate packings of a content exceeding 2 kg.

073.3 - Other food preparations containing cocoa, in blocks, slabs or bars, whether or not filled

073.9 - Other chocolate and food preparations containing cocoa n.e.s.

074.1 - Tea, whether or not flavoured

074.3 - Maté; extracts, essences and concentrates of tea or maté, and preparations with a basis of tea, maté, or their extracts, essences or concentrates

075.1 - Pepper of the genus Piper; fruits of the genus Capsicum or of the genus Pimenta, dried or crushed or ground

075.2 - Spices (except pepper and pimento)

081.1 - Hay and fodder, green or dry

081.2 - Bran, sharps and other residues, whether or not in the form of pellets, derived from the sifting, milling or other working of cereals or of leguminous plants

081.3 - Oil-cake and other solid residues (except dregs), whether or not ground or in the form of pellets, resulting from the extraction of fats or oils from oil-seeds, oleaginous fruits and germs of cereals

081.4 - Flours, meals and pellets, of meat or meat offal, of fish or of crustaceans, molluscs or other aquatic invertebrates, unfit for human consumption; greaves

081.5 - Residues of starch manufacture and similar residues, beet pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets

081.9 - Food wastes and prepared animal feeds, n.e.s.

091.0 - Margarine; edible mixtures or preparations of animal or vegetable fats or oils or of fractions of different such fats or oils, other than vegetable fats or oils or their fractions of subgroup 431.2

098.1 - Homogenized food preparations

098.4 - Sauces and preparations therefore; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard; vinegar and substitutes for vinegar obtained from acetic acid

098.5 - Soups and broths and preparations therefor

098.6 - Yeasts (active or inactive); other single-cell micro-organisms, dead (but not including vaccines of heading 541.63); prepared baking-powders

098.9 - Food preparations, n.e.s.

Source: United Nations Statistics division website