

**CHARLES UNIVERSITY**  
**FACULTY OF SOCIAL SCIENCES**

Institute of Economic Studies



**Analysis of the EU - South Korea FTA  
and its effects on their mutual trade using  
the gravity model**

Master's thesis

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Year of defense: 2020

## **Declaration of Authorship**

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Prague, July 31, 2020

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Katarina Vinsova

## Abstract

The European Union (EU) and South Korea signed the EU- South Korea free trade agreement (FTA) in 2011 and since then they started to gradually remove barriers to their mutual trade. This thesis is analyzing the effects of this agreement on their bilateral trade flow in 10 commodity sections from 2005 until 2018. For this analysis we are using gravity model that is estimated by OLS and PPML method for comparison. This analysis showed that the EU-South Korea FTA influences their mutual trade in all 10 sections differently due to different levels of protectionism at the beginning. The FTA had a positive influence on their mutual trade in 9 commodity sections out of 10. In the Section 9 we found a negative effect of the FTA. Contrary to our beliefs we also found out that the highest increase in their mutual trade was not in automobile and electronic industry but in the chemical industry.

<b>JEL Classification</b>	C23, F14, F33, C16
<b>Keywords</b>	Free Trade agreement, South Korea, European Union, gravity model
<b>Title</b>	Analysis of the EU - South Korea FTA and its effects on their mutual trade using the gravity model
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## Abstrakt

Európska Únia (EU) a Južná Kórea uzatvorili medzi sebou dohodu o voľnom obchode v roku 2011 a postupne začali odstraňovať prekážky vzájomného obchodu. Táto práca skúma práve efekt tejto dohody na ich vzájomný obchod v jednotlivých sekciách produktov (SITC) od roku 2005 do 2018. K analýze využívame gravitačný model, ktorý odhadneme metódou OLS a PPML na porovnanie ich účinnosti. Táto analýza ukázala, že Dohoda o voľnom obchode medzi EU a Južnou Kóreou ovplyvnila ich vzájomný obchod vo všetkých sekciách, avšak v každej sekcii do inej miery z dôvodu rozličných počiatkových prekážok v každej sekcii. V 9 z 10 sekcií mala dohoda pozitívny vplyv na ich vzájomný obchod ale v sekcii SITC 9 sme našli negatívny vplyv dohody

na vzájomný obchod. Napriek našim očakávaniam, najväčší nárast nebol zaznamenaný v automobilovom a elektrotechnickom priemysle ale podľa našej analýzy najvyšší nárast zaznamenal práve priemysel chemický.

<b>Klasifikace JEL</b>	C23, F14, F33, C16
<b>Klíčová slova</b>	dohoda o voľnom obchode, EÚ, Južná Kórea, gravitačný model
<b>Název práce</b>	Analýza Dohody o voľnom obchode medzi Európskou Úniou a Južnou Kóreou a jej efekt na ich vzájomný obchod pomocou gravitačného modelu
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# Acronyms

**FDI** Foreign Direct Investment

**FTA** Foreign Trade Agreement

**EU** European Union

**SME** Small and Medium sized enterprises

**RTA** Regional Trade Agreement

**GATT** General Agreement on Tariffs and Trade

**MFN** most favored nation

**RTA** Regional Trade Agreement

**PTA** Preferential Trading Agreement

**NAFTA** North American Free Trade Agreement

**APEC** Asia-Pacific Economic Cooperation

**WTO** World Trade Organization

**ASEAN** Association of South East Asian Nations

**CEFTA** Central European Free Trade Agreement

**GSP** Generalised System of Preferences

**MRT** Multilateral Resistance Term

**OECD** Organization for Economic Co-operation and Development

**SITC** Standard International Trade Classification

**OLS** Ordinary Least Squares

**PPML** Poisson Pseudo Maximum Likelihood

**AFTA** ASEAN Free Trade Area

**CER** Australia - New Zealand Closer Economic Relations Trade Agreement

# Master's Thesis Proposal

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<b>Author</b>	Bc. et Bc. Katarína Vinšová
<b>Supervisor</b>	Mgr. Michal Paulus
<b>Proposed topic</b>	Analysis of the EU - South Korea FTA and its effects on their mutual trade using the gravity model

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**Motivation** The EU - South Korea Free trade agreement (FTA )'s talks started in 2007. The FTA was then signed in October 2009, has been provisionally applied in July 2011 and has been ratified in December 2015. All in all it is a trade - oriented Preferential Trade agreement (Gardoňová, Prno, 2017) that started to be considered in 2007 as the EU was the second largest importer of South Korean goods and South Korea was the eighth largest importer of the EU goods (European Commission, 2018).

Nowadays, FTAs focus more on harmonization and mutual recognition of different regulations compared to traditional FTAs that are focusing on tariff liberalization. The EU - South Korea FTA also mostly focus on these aspects of trade and also strengthens trade relations between the two parties (Kang, 2017). In particular, it eliminates duties for industrial and agricultural goods (European Commission, 2018).

Some effects of the FTA on the two countries' mutual trade were already pointed out by several economists. For example, this FTA affected negatively the EU's trade with Japan and Japanese companies as EU increased imports of Korean goods (especially automobiles and electronics). There are also some expectations that the trade deals that are being negotiated in Asia right now will become more important for South Korea than the EU - South Korea FTA due to the structural changes in the Korean economy (Amighini, 2016). These and some other changes could benefit from deeper analysis that this thesis will provide.

## Hypotheses

Hypothesis #1: The EU - South Korea FTA agreement has positively affected their mutual trade.

Hypothesis #2: Not all industries of their mutual trade are impacted by this agreement.

Hypothesis #3: The biggest impact of the FTA can be seen on the most discussed automobile and electronics' industry.

**Methodology** In my thesis I will apply gravity model of the international trade to find out which goods' category trade benefitted the most from the EU - South Korea agreement. Firstly, I will focus on the exports of both countries as whole. Secondly, I will research the effects of the FTA on 10 basic SITC categories. Lastly, I will see how the exports of automobiles and electronics changed since the FTA has been in place as these two products' categories were among the most discussed ones in the process of FTA making.

The first version of the gravity model was suggested by Tinbergen (1962) and Poyhonen (1963). In their version they showed that exports are affected by income of the trading countries positively and by distance between the countries negatively. Over the years several researchers contributed to this idea. For example Anderson (1979) assumed product differentiation in his analysis and Bergstrand (1985) showed that price and exchange rate both have a significant effects on trade flows. Anderson and Van Wincoop (2003) then developed a methodology based on gravity theory and laid ground for the microfounded gravity as they have proved that gravity equations are not theoretically grounded.

In my analysis I will test to find out the effects of the EU - South Korea agreement on their mutual trade as well as on the specific industries' trades by using the structural gravity model. Authors, such as Baier and Bergstrand (2007), showed through gravity model that FTAs have impact on countries' mutual trade and I will further develop my model on this theory.

**Expected Contribution** The contribution of my thesis is mostly empirical. The topic of the EU - South Korea FTA has not been examined yet since the FTA has not been in place for that long. Majority of the works related to this FTA is written about the implementation of the FTA, the expected effects and about the issues that have arisen during the negotiations. Therefore, this thesis will be among the first ones to assess the EU- South Korea FTA's proper effects.

Despite the fact that the FTA is not in place for that long, its effects can be seen already. For example, since 2011 the EU's exports of goods to Korea increased by 35% already by 2014 also thanks to this agreement. The FTA also had a negative impact on the EU's trade with Japan. Hence it already makes sense to start evaluating this FTA empirically.

Moreover, the thesis will show the effects not only on the exports as whole but also the FTA's effects on the different categories of goods' exports. This is also expected to show the changes especially to the automobile and electronics industries as they were the most problematic ones during the FTA's negotiations.

## Outline

1. Motivation: there are meta-analyses on the price elasticity of gasoline demand, but they do not correct their estimates for publication bias. Publication bias has been shown to distort most areas of empirical economics, so there is a good chance it will be important here as well.
2. Studies on gasoline demand: I will briefly describe how people estimate the price elasticity of gasoline demand.
3. Data: I will explain how I will collect estimates from studies estimating the elasticity.
4. Methods: I will explain modern meta-analysis methods, including the funnel asymmetry test, precision effect test, and multilevel variants of these regressions.
5. Results: I will discuss my baseline regressions and robustness checks.
6. Concluding remarks: I will summarize my findings and their implications for policy and future research.

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Supervisor

# Chapter 1

## Introduction

Since the end of the World War II the world trade has been increasing and gaining importance in support of globalization. Set of rules called General Agreement on Tariffs and Trade (GATT) culminated in establishing World Trade Organization (WTO) that have been making the world trade easier. The latest negotiations called The Doha Round that is aiming to achieve major lowering of trade barriers in 20 areas of trade launched in 2001. However the negotiation reached a stalemate that lead to the world trade's trend to shift to bilateral Foreign Trade Agreement (FTA) (Muzaka & Bishop 2015). FTA have been a very important tool in achieving free trade since they have been slowly gaining importance since the year 1860 when the first FTA - Cobden - Chevalier Treaty was signed between Great Britain and France.

The EU - South Korea FTA is a new generation FTA that is really ambitious. It's goal is to eliminate 99% of tariffs not only on products but also on services. It is ambitious also in eliminating non-tariff barriers to trade. The agreement was signed in 2010 and provisionally applied in 2011 to ensure that the transition of extensive tariffs' elimination is gradual. When the FTA took effect in December 2015 99% of tariffs were already gradually removed based on the tariff schedule. The remaining 1% of the product's tariffs will be eliminated gradually until 2032. For the EU, this agreement was the first one with and Asian country as well as the first one with a developed economy (Plaisier *et al.* 2018). For the South Korea it was one of many FTA that they have been signing in the 21st century but it is also one of the most ambitious.

As the agreement had not been in effect that long there is almost no research done about its ex-post effects on EU and South Korea's mutual trade. EU's research of this topic includes mostly descriptive statistics of the data. This thesis

analyzes the FTA effects through gravity model. Theoretical gravity model had been derived by Anderson & Van Wincoop (2003) and became commonly used to analyze trade flows between countries. Therefore this thesis analyzes the effect the FTA has on members' mutual trade and also tries to identify in which industry the effect is the highest. For such analysis, we will use the Ordinary Least Squares (OLS) method as well as the Poisson Pseudo Maximum Likelihood (PPML) method. PPML regression accounts for zero trade flows in data as well as for the heteroskedasticity and therefore should yield better results than the OLS regression.

The dataset contains panel data of unilateral trade flows between countries of the world for each category of Standard International Trade Classification (SITC) Revision 2 during the years 2005-2018 to capture several years before the FTA negotiations started as well as 5 years after the agreement took full effect which might be caused by the highest level of protectionism in this industry.

According to the analysis, the EU - South Korea FTA affected the trade positively in all of the SITC categories, except of the SITC 9 - Commodities and transactions not classified elsewhere in the SITC. Trade in all of the categories was affected by a different amount. Category SITC 5 - Chemicals and related products, n.e.s. experienced the highest increase in trade since the FTA took effect.

The thesis is structured as follows: Chapter 2 introduces the EU - South Korea FTA and the gravity model. It also contains literature review of the relevant literature for the thesis. Chapter 3 summarizes the issues that comes up while using gravity model and ways how to correct them. Chapter 4 sums up the data and methodology used for the analysis in the thesis. Chapter 5 discusses the results of two regressions for each product sections separately. Chapter 6 discusses the results and answer the three hypotheses. In the end, Chapter 7 summarizes the findings.



# Chapter 2

## Literature Review

### 2.1 What is the EU - South Korea FTA?

The negotiations between the EU and the South Korea about possible FTA started in May 2007. The two parties held eight official rounds of negotiations about the FTA. In October 2010 it was approved by the European Council and in February 2011 the FTA was also approved by the European Parliament. Therefore, in July 2011 the EU- South Korea's Free Trade Agreement was provisionally applied and after approval of all the EU's Member state it formally entered into the force on 13 December 2015. As any other FTA its main goal it is to eliminate duties for traded goods, in this case mostly duties for industrial and agricultural products. The FTA was at first applied only provisionally to ensure that the process of tariffs' elimination is going to be gradual so that the businesses have enough time to adjust (European Commission, 2019).

The main objective of this agreement is to eliminate tariffs on almost all industrial and agricultural products, with the exception of rice (Plaisier *et al.* 2018). Each product category has its own timeline of elimination of tariffs.

According to the tariff schedule of the FTA 70% of the tariffs was eliminated in July 2011 when the FTA was provisionally applied. All the tariffs on industrial goods will be eliminated in 5 years since provisionally applying the FTA. Some agricultural goods will undergo even longer transitional period for reducing the tariffs and rice will not be liberalized at all. Tariffs on 70 % of the imported goods were eliminated in 2011, 90 % of the tariffs were eliminated by year 2014 and by year 2016 99 % of tariffs has been eliminated. The reason behind this slow transitional process in some goods is to help producers to gradually adapt to the lower tariff rates (European Commission for Trade, 2019).

The tariff schedule of Korea was divided into different staging categories that represent the amount of years when the tariff is going to be fully eliminated. The staging categories range from 0 to 21 which means that some tariffs will be completely removed only in 2032. For example, tariffs on cosmetics imported to Korea were 8% and in the year of provisional application of the FTA in 2011 tariffs on approximately 70% of cosmetic products were eliminated completely. In a 3-year-long period tariffs were eliminated also on perfumes, shampoos, etc. and by 2016 tariffs were eliminated also on skin care products and face powder to complete tariff elimination of cosmetics imported to Korea from the EU (European Union, 2019). Summary of some chosen products' tariffs can be seen in a following table:

Table 2.1: Changes of duties after the implementation of the EU-South Korea FTA

<i>Industry</i>	<i>Trade Country</i>	<i>Tariffs in %</i>	
		<i>Before FTA</i>	<i>After FTA</i>
Cosmetics	EU → Korea	8%	0% in 5 years
	Korea → EU	0 %	0%
Pharmaceuticals	EU → Korea	6.2%	0% in 3 years
	Korea → EU	0 %	0%
Medical Devices	EU → Korea	5%	0% in 7 years
	Korea → EU	0 %	0%
Chemicals	EU → Korea	6.2%	0% in 7 years
	Korea → EU	4.8 %	0% in 7 years
Machineries and Electronic Appliances	EU → Korea	7.2%	0% in 7 years
	Korea → EU	3 %	0% in 5 years
Alcohol beverages -Wine, Champagne -Cognac	EU → Korea	15%	0% immediately
	EU → Korea	15 %	0% in 5 years
Textile products (for 99% of products)	EU → Korea	8%	0% in 5 years
	Korea → EU	0 %	0%
Iron and Steel Products	EU → Korea	7.2%	0% in 3 years
	Korea → EU	3.1 %	0% in 3 years

*Source:* Kim & Chang (2011)

According to Gardoňová & Prno (2017) the eight rounds of negotiations between the FTA's parties were mostly discussing following concerns:

- The automotive sector has raised concerns about rules of origin of Korean cars that are more and more often including parts from China,

- The European Union's textile industry was worried about increased competition from the Korean markets (similar to the Chinese textile products that provided cheap and low-quality textiles that European companies could not compete with)
- Pharmaceutical and medical industry proved to be troublesome as Korean medical regulations and certifications are difficult to obtain by European companies

The EU is using 3 types of trade agreements to support their trade with non-member countries, such as customs unions; association agreements, free trade agreements, economic partnership agreements; and partnership and cooperation agreements. As of 2019 the EU has 76 trade agreements in place, 25 trade agreements being ratified and 6 trade agreements that are being negotiated. Out of these trade agreements there are only three FTA in place- Singapore FTA, South Korea FTA and Ukraine Deep and Comprehensive FTA. Vietnam FTA is being ratified as of 2019 and Indonesia FTA as well as Philippines FTA are being negotiated (European Commission, 2020). In 2006 the EU started a new policy of new generation of FTAs with its most strategic partners. These FTAs would aim for a higher level of trade liberalization by achieving not only economic liberalization but also some level of service liberalization. Through these ambitious FTA the EU is trying to gain greater market access and deepen cooperation with important trade partners. According to Pollet-Fort (2011) there are 3 main reason behind this shift to new generation FTA:

1. hampered negotiations of the WTO's Doha Development Agenda,
2. changes of other countries' trade policies,
3. increased economic growth in Asia.

The first FTA of these new generation FTA is the EU- Korea FTA that should serve as a "benchmark" for future EU's FTA. That is one of the reasons why the negotiations time took 4 years. The decision to make this FTA a model for other new generation agreements was based on political motivation as well as economic motivation, such as economic size and growth of partner countries, tariffs and non-tariff barriers. Beside the fact that the EU-South Korea FTA was the first one of the new generation FTA signed by the EU it was also the first FTA between the EU and an Asian country at the time and the first EU's FTA with a developed economy (Plaisier *et al.* 2018).

The motivation of the EU to sign the EU-Korea FTA came from the fact that Korea was the EU's fourth largest non-European trading partner and because Korea experienced great economic growth in past 45 years showing signs of future growth potential. Through this FTA the EU was also hoping to get an entry point to the rapidly growing East Asian market and for Korea to ease up the non-tariff barriers such as specific standards and testing procedures that European businesses had to undergo if they wanted to enter the Korean market (Pollet-Fort 2011).

As the global trade has become more and more defined by countries forming the FTA, Korea had to join this global trend as their economy has been export - oriented since the 1960s. In 2008 70% of South Korea's GDP was dependent on foreign trade while in 2019 it was already 90% of South Korea's GDP that was dependent on foreign trade. South Korea is promoting FTA since 1998 but they were still a little bit behind the trend as in 2003 South Korea and Mongolia were the only two countries out of the without any active FTA (Liou 2008). Since then South Korea has become very proactive in adopting new FTA. In less than 20 years they have managed to sign 41 trade agreements, out of which 31 agreements are the FTA. South Korean economy was always characterized by its speed to achieve something.

According to Kang (2019) South Korea is planning to gain 12 more FTA by year 2022. That would result in their presence in 90% of the world's economies. One of the reason for the fast pace of FTA signing is to decrease the dependence on China and the USA that account for 40% of its exports <sup>1</sup>

## 2.2 Gravity Model

At the beginning of this chapter a short introduction of the gravity model will be given. The chapter will cover gravity model's development throughout the years. Afterwards various literature is reviewed to show the impact of the FTA on trade.

### 2.2.1 Introduction to Gravity Models

Gravity model has been gaining popularity since it has been discovered by Tinbergen (1962). It has been considered to be a very good physical analogy

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<sup>1</sup>South Korea signed People's Republic of China - Republic of Korea FTA in 2015 and Republic of Korea - United States Free Trade Agreement in 2012.

with positive empirical characteristic and in many cases, it has great results. The popularity of the gravity models lies in the simplicity and in the way how easily the model can approximate existing data.

Gravity models of trade has gained importance in international economics in the last four decades as it has been used widely in analyzing international trade flows. Basic gravity model of international trade explains bilateral trade flows between two countries, regions or group of countries through a function of the sizes of two parties' economies and their mutual distance. The basic expectation behind the gravity model is that countries with bigger economies trade more, and that countries further away from each other trade less (Shepherd *et al.* 2019).

Over the years it has been mostly modified by adding new explanatory variables, such as per capita GDP, history, race etc. (Liu 2018).

The basic principle behind gravity model is that it follows the physical principle of gravity. Tinbergen (1962) based the gravity model on Newton's Law of Universal Gravitation:

$$F_{ij} = G \frac{m_i m_j}{r^2} \quad (2.1)$$

where  $F_{ij}$  is the gravitational force between 2 objects,  $G$  is the gravitational constant,  $m_i$  and  $m_j$  are the masses of the objects and  $r$  is the distance between objects  $i$  and  $j$ .

Based on the Equation 2.1 Tinbergen (1962) proposed gravity model equation to explain international trade flows:

$$T_{ij} = G \frac{Y_i Y_j}{D_{ij}} \quad (2.2)$$

where  $T_{ij}$  stands for a trade flow,  $G$  is a constant,  $Y_i$  and  $Y_j$  stands for a variable measuring the economic size of the countries  $i$  and  $j$  ( most commonly used are the values of gross domestic product of the country  $i$  and  $j$  ), and  $D_{ij}$  stands for the geographical distance between countries  $i$  and  $j$  which is actually an observable proxy for measuring trade costs between two countries.

Expressed in logarithmic form it takes on the form:

$$\ln(T_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(D_{ij}) + u_{ij} \quad (2.3)$$

where  $\beta$  are the coefficients and  $u_{ij}$  is a random error term. The coefficients  $\beta_1$  is expected to be positive and the coefficient  $\beta_2$  is expected to be negative.

The following section will cover the evolution of the Gravity model.

### 2.2.2 Intuitive Gravity Model

As described in the previous subsection the intuition behind gravity model lies in the idea, that trade flows are influenced by gravitational forces. Traditionally the gravity model was based only on the intuitive idea that countries with larger GDPs trade more than the countries with lower GDPs and that countries close to each other trade more between themselves than countries further away from each other (Shepherd *et al.* 2019).

This basic model is usually strengthened by certain dummy variables that have an effect on bilateral trade. The most typical dummy variables are common language, shared border, colonial ties, members of a common trade union, FTA between the countries of interest, per capita GDP, shared history, common race etc. (Liu 2018). These dummy variables can stand for political, cultural as well as geographical barriers to trade and by including them in the basic model they can help to increase its significance. It has been proven by many studies that common language, border, history, race etc. promote deeper connections between two countries which further deepens economic ties.

However, the intuitive gravity model was criticized due to the lack of theoretical foundation. It also cannot account for some issues. As it was shown later in theoretical gravity model, it does not account for the effect that a change in the trade costs of the two countries has on the third country. For instance, an FTA between the European Union and South Korea increased the trade between these two parties. On the other hand, it probably decreased the trade between the European Union or South Korea and a third party. Therefore in the last 20 years gravity model's theory started to spread and Structural Gravity Models started to gain importance (Shepherd *et al.* 2019).

### 2.2.3 Theoretical Gravity Model

At the beginning the gravity model was struggling with poor theoretical background to support its intuitive theory. At first all the empirical researches using gravity models were not even trying to provide any theoretical background. The theory of gravity models has been provided a bit later and it showed that the

model can also be proved through a traditional theory of trade. But since the second half of 1970s there has been several formal theoretical discoveries in support of gravity model. Anderson (1979) made first formal try to deduce a gravity equation from a model that assumed products' differentiation (products were differentiated according to the country of origin). At first, he was using Cobb-Douglas preferences. Bergstrand (1989) searched for the theoretical background for the bilateral trade in several papers. In his paper he is moving further away from Heckscher- Ohlin model and closer to an assumption of monopolistic competition, i.e. he differentiated products based on companies and not based on countries. Later Deardoff (1995) proved that the gravity equation characterizes many models and can be derived from the classical theory of trade.

Groundbreaking paper related to the theoretical gravity model was written by Anderson & Van Wincoop (2003). Amongst all the Structural Gravity Models their "Gravity with Gravitas" is the most widely used theory-based model. By trying to show the effect of the US-Canadian border on the trade between the two countries they pointed out that trade barriers between the US and Canada must be taken into account relatively to all other trade barriers these two countries had.

$$\log(X_{ij}^k) = \log(Y_i^k) + \log(E_j^k) - \log(Y_j^k) + (1 - \sigma_k) [\log(\text{distance}_{ij}^k) - \log(\prod_i^k) - \log(P_j^k)] \quad (2.4)$$

They showed the most important theoretically derived variables, that are  $\prod_i^k$  and  $P_j^k$  which represents outward and inward Multilateral Resistance Term (MRT). The outward MRT  $\prod_i^k$  represents the dependence of exports from country  $i$  to country  $j$  on the trade costs of all other export markets. The inward MRT  $P_j^k$  represents the dependence of imports from country  $i$  to country  $j$  on the trade costs of all other import markets. In other words the MRT accounts for the effect that any change of trade costs between two countries  $i$  and  $m$  has an influence also on the trade between countries  $i$  and  $j$ :

$$\frac{\delta \log(X_{ij})}{\delta \log(\text{distance}_{im})} \neq 0 \quad (2.5)$$

One of the main issues of the Gravity with Gravitas model is that these

added MRTs are unobservable variables and therefore they have to be estimated. One of the solutions is to add *distance* variable as MRT's proxy. In the case of disaggregated trade flows, it should ideally be estimated through a country's sectoral expenditure and output. As this data is usually not documented, especially if the model includes developing countries, a country's GDP is a suitable proxy variable (Shepherd 2016). This suitable solution has been applied in this thesis as well.

## 2.3 Effects of FTA on the International Trade

The globalization of the world economy and the world trade has been developing very fast since the end of the World War II. The world trade has been having an increasing trend for many decades now. Even through some slowdowns over the years the global trade's growth rate in 2017 reached its highest growth rate in 6 years. There has been 4 136 % growth in the world trade from 1950 to 2018 (WTO, 2019a).

The world trade has been made easier with the set of rules called the GATT that culminated in establishing the WTO in 1995. Even thanks to this, the trade costs have been continuously decreasing as well as the tariff rates that have been decreasing rapidly since 1997. All of this lead to the world trade increasing (Suciono 2016).

One of the goals of the WTO is to achieve regional integration. WTO is trying to achieve this goal through Regional Trade Agreement (RTA). RTA are trying to support trade between countries or group of countries by eliminating trade barriers between them. The most common RTA are Preferential Trading Agreement (PTA) and FTA. The PTA is the simplest form of the RTA in which imports between the member countries are realized at a preferential rate. Few examples of the PTA are Former Trust Territory of the Pacific Islands, South Pacific Regional Trade and Economic Cooperation Agreement, South Pacific Regional Trade and Economic Cooperation Agreement etc.(WTO, 2019b). On the contrary the FTA are agreements to eliminate barriers to trade in goods and services among member countries. At the same time the member states continue to have their own barriers to trade for import for the non-member countries. Examples of FTA include EU- South Korea FTA, the North American Free Trade Agreement (NAFTA), Asia-Pacific Economic Cooperation (APEC) etc.



Lindert (1991) categorized different stages of integration:

- (a) FTA- an agreement between countries or groups of countries which eliminate tariffs and quotas
- (b) Custom union- creates common tariffs for all other countries
- (c) Common market- eases control on the migration within the countries
- (d) Economic union- common macroeconomic policies are followed to achieve common goals of participating countries

According to this, FTA are the loosest kind of integration. FTA are a general exception of the most favored nation (MFN) rule of the WTO (WTO, 2019a)<sup>2</sup>. Urata & Okabe (2007) calculated that there has been a steep increase in the number of FTA being ratified since the mid- 1990s. He also pointed out some specific characteristics of FTA, such as (i) they are including increasing number of members and instead of creating new FTA there is a trend to extend and deepen the existing FTA, (ii) FTA are getting deeper and more detailed while focusing on traditional goals, such as eliminating the trade barriers, but also on new objectives, such as liberalization, addition of services, Foreign Direct Investment (FDI) and intellectual property rights and rules on the dispute settlement, (iii) formation of FTA between countries that are not that geographically close (e.g. FTA between the European Union and the South Korea), (iv) more and more countries are participating in some forms of the FTA (e.g. South Korea which first FTA came into force in 2000 or Japan which first FTA came into force only in 2002), (v) establishing more informal regional agreements.

Frankel (1998) argues that behind each FTA there is a blend of political, economic, as well as security elements that can be external and internal. Over the years these concerns have been changing and losing or gaining importance. Nevertheless, looking for new market opportunities and securing new markets has been the most important external factor to be considered when looking for a new trading partner. Nowadays it is not just about looking for a new trading partners but also about not losing a trade partner due to possible partner's FTA with another country.

It is also important to mention that the trade is influenced not only by the world markets but also by the economic conditions of each country, rising

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<sup>2</sup>Most favored nation rule is a basic principle of non- discrimination of all members of the WTO according to the GATT Article 1.

population, increased disposable income, more demand for foreign goods etc. and all these factors have to be carefully considered before signing each FTA. Baier & Bergstrand (2007) empirically proved that FTA have increased members' international trade. Suciono (2016) showed that in vast majority of cases FTA increase trade volume between the members. He also pointed out that the impact of the new FTA is not as big as the effect FTA used to have at the beginning of globalization.

There are some pros and cons to each FTA. Winters (1991) divided the economic effects of the FTA into

### 1. Static effects

- Trade creation, i.e. trade is created by removing or loosening trade barriers between countries
- Trade diversion, i.e. less demand from the FTA members to import products from the FTA's nonmembers <sup>3</sup>
- Terms of trade effect, i.e. FTA have effect also on the FTA' nonmembers trade as they often promote trade between the members at the expense of non-members,

### 2. Dynamic effects

- Market expansion, i.e. countries have more option when deciding where it is the most effective to produce the product
- Competition enhancement, i.e. market integration is making oligopolies more competitive and thus improving even members' companies

Alessia (2015) pointed out 6 advantages and 7 disadvantages of the FTA:

### 1. Advantages:

- Boost in economic growth
- More dynamic and competitive business environment
- Decrease in government spending
- Boost in the FDI
- Access to the know-how of the global companies

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<sup>3</sup>Majority of times the trade creation overshadows the trade diversion and the FTA results in GDP gain.

- Access to the latest technologies

## 2. Disadvantages

- Higher risk of job outsourcing
- Loss of intellectual properties, such as patents, inventions etc.
- SME cannot compete with international companies
- Poor working conditions in countries without proper labor protections
- Decrease of natural resources, e.g. through more- intensive deforestation
- Loss of indigenous cultures
- Loss of revenues from import tariffs.

According to Liu (2018) the trade effects of are economic and non-economic and they differ for important world players and for small countries. For example, the economic growth gained through FTA is more important for small countries than for big powers who are mostly looking for better bargaining positions in the world negotiations as well as traditional trade gains. Meanwhile small countries can attract investments, grow economically and expand markets through FTA. The non-economic benefits of world economies include promoting of their own political systems and global hegemony while for small economies it represents stable supply of public goods, such as security, energy, etc.

Lopez-Gonzalez (2012) is arguing that FTAs are influencing also vertical specialization of companies. He proved that countries involved in some form of FTAs import more intermediate inputs from FTA's members than from FTA's nonmembers. He also points out that world trade is interlinked to that extent that an FTA signed between two countries has much bigger impact that goes beyond the two parties signing the agreement.

There are also some controversies related to the FTA. One of the biggest one is people's worry about the job loss or brain drain. Brain drain is mostly related to the FTA between developed and developing countries when many workers travel to a developed country in the view of better and more prosperous future. Plaisier *et al.* (2018) pointed out that the fact that a country has a FTA does not automatically mean that it is also used by businesses to its full potential.

Many of the processes can be time and resource consuming and this proved problematic especially for the Small and Medium sized enterprises (SME) which are lacking resources. Other problems might include difficult communication between the two involved parties, language and cultural differences.

According to WTO (2019) there has been a proliferation of RTA<sup>4</sup>. In the year 1990 there has been only 22 RTA in force. This number increased to 82 RTA in force by year 2000 and more than doubled to 214 RTA in force in 2010. As of November 2019, there are 302 RTA in force all over the world. Urata & Okabe (2007) attributed the fast expansion of FTA in the 21st century to several factors. One of the reasons for the growing number of the FTA is that in the 1990s the FTA were mostly established in Europe, Africa and America, but since the beginning of the 21st century East Asian region started establishing them as well. East Asian countries, including South Korea, were worried that the exclusion from the growing number of FTA in the world will have a negative economic impact on them. Another reason is the standoff of the Doha Development Round, trade negotiation of the WTO with the goal of lowering trade barriers all over the world. Countries disappointed by this stalemate started to pursue bilateral trade liberalization options, such as FTA.

## 2.4 FTA estimations using Gravity Models

As the aim of the thesis is to estimate the effects of the EU- South Korea FTA on the trade between South Korea and the EU member states the first part of the reviewed literature will mainly focus on the impact of FTAs on the world trade using gravity models in general and then the second part of this section will focus on the assessments of chosen EU's and South Korea's FTAs.

The gravity equation is one of the common methodologies to study the effects of FTA on the international trade (Urata & Okabe 2007). Nowadays gravity models are commonly used for ex-post analysis of economic effects of an FTA thanks to its high explanatory power (Plummer *et al.* 2010). The effect of FTA on trade flows using gravity models are diverse as seen from following literature review. The basic gravity model equation has been used to analyze impact of WTO membership, currency unions, migration flows, foreign direct

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<sup>4</sup>FTA are far more common than custom unions and therefore for the purpose of this thesis we use the WTO statistic for the FTA and RTA interchangeably. As of 2017 custom unions represented only 6 % of the RTA

investments, disasters as well as the effects of FTAs. In order to analyze the effects of the FTAs on trade flows economists added a dummy variable for when the countries or groups of countries  $i$  and  $j$  have signed an FTA. Other economists added different variables capturing trade costs, such as common language, common currency, shared border, colonial ties etc. (Plummer *et al.* 2010).

The prevailing opinion amongst recent studies of the effects of FTA using gravity models is that despite such expectations there is not enough evidence of their positive effect on trade diversion nor the trade creation (Baier & Bergstrand 2007). These mixed results can be seen in the work of Frankel *et al.* (1995) who applied gravity model to few major FTA i.e. the EU, the NAFTA, the MERCOSUR and the ASEAN Free Trade Area (AFTA) and while they found positive effects for the MERCOSUR and the AFTA, they found no positive effects on the world trade for the EU and the NAFTA.

Urata & Okabe (2007) were looking for the impacts of FTA on trade flows and were looking for the trade creation and trade diversion effects. They also found quite mixed results. Out of 11 tested FTA the gravity equation for total exports showed the trade creation effect only for the AFTA, the Australia - New Zealand Closer Economic Relations Trade Agreement (CER) and Korea-Chile FTA and the trade diversion effect was observed only for the NAFTA, the MERCOSUR and the EU- Mexico FTA. The analysis for different product categories then showed different results for all the FTA as well as all the product categories. In general it showed that the MERCOSUR is very closed economy to the world trade while the AFTA and the CER are quite opened economies compared to other FTA tested. The limit of the study was the fact that some of the FTA had quite a short history to show their full potential that can be seen only in the long-run.

Several studies has also shown differences in the FTA effects for developing and developed countries using gravity model. Huijskens (2017) showed that dependency of the developing countries on the developed countries as their export destination had a negative effect on the profits for the developing countries from the liberalization of the trade. Poor infrastructure and low level of technologization can also impede developing countries benefitting from FTA as it is more difficult to adjust to higher demand of their products. On the contrary the gains from the FTA for the developing countries might be higher

in the long-run. Chandran (2005) proved that India would benefit from joining the Association of South East Asian Nations (ASEAN) with some form of the RTA. Therefore his research supports the theory about developing countries benefitting more from the FTA, especially in the short term. In this case it is due to higher tariff levels in India compared to other ASEAN countries.

Opposite from majority of the studies (Dong 2014) argued that too many signed FTA by one country lead to a trade protection measure by that specific country. Using a gravity model, he proved that FTA regulations could also lead to a reduction of trade amongst the countries outside of the FTA's circle.

Sohn (2005) used gravity model to estimate the effect of Korean APEC membership and found out that the gravity model he used does not explain its effect properly. He found mixed results according to which he came to a conclusion that some other factors that are not accounted for in the gravity model are effecting Korea's bilateral trade with certain APEC members. For example, the trade with Chile was underpredicted by the gravity equation and in real life Chile exports to Korea are far higher than according to his results. He also tried to use the gravity model to an economic relationship between North and South Korea. Based on the gravity equation he found out that the economies of the two countries complement each other but are not using their potentials to the fullest. By liberalizing their mutual trade and by easing up some of the unnecessary barriers to trade their mutual trade could grow as much as 50%.

Nam *et al.* (2013) applied gravity model on the Korea- Chile FTA because there was not enough literature discussing the FTA's effects. He found out that the trade volume between the two countries has risen significantly in volume. This increase was already visible 7 years after the FTA took effect. As he decided to analyze the FTA's effect on Busan port he interestingly found out the maritime freight rate is insignificant in his model.

Guilhot (2010) analyzed three "major" FTAs signed by ASEAN, i.e. FTA within the ASEAN itself, FTA between ASEAN and China and between ASEAN and South Korea. She pointed out the fact that as the WTO rules are set up to promote international trade they also promote trade between Korea and its neighbors. That is also one of the reasons why the gravity model in this case did not show any significant increase in trade since the ASEAN - Korea FTA took effect. Another reason for this insignificant increase was that the

agreement took effect only in 2007 and the analysis was done only two years after it took effect. Therefore it also supports the theory of (Huijskens 2017) that the developing countries will see the effects of signed FTAs only in the long-run.

Vast majority of research done about the FTA focuses on the impacts of FTAs on the trade value. Jun *et al.* (2014) tried to use gravity model approach to estimate the effect of Korea's FTAs on the port trade volumes. During the time of his research Korea had signed FTAs with 47 countries and regions and trade volume amongst South Korea and the countries they have signed the FTAs with accounted for 25% of its total trade volume. In his study he confirmed basic gravity model assumptions, such as the greater the distance between the trading partners, the smaller the trade volume between the two as well as increased Korean imports and exports as the trading partners' GDP grew.

Another research by Slootmaekers (2004) about the EU - Mexico FTA supports the theory of the FTA having a positive effect on trade. The research found out that there is a positive trade creation effect of the FTA on imports between Mexico and all of the EU countries. Baier & Bergstrand (2004) also proved that the FTA increases members' international trade using the gravity equation. However they researched only the effect the FTA has on the trade between members of an FTA and therefore their study is limited and it does not prove how the trade with non-members is affected by forming an FTA.

Lim (2011) used the gravity model approach not only on the EU but also on the NAFTA and the AFTA. The approach supports the theory that FTA do not stimulate trade not only between the FTA members themselves but also between non-members as well which is showing support to multilateralism. But as expected all three FTA generate more intra-FTA trade than extra-FTA trade. She also pointed out the asymmetry between the profits from the FTA. In other words, she pointed out that some economies tends to benefit from FTA more than others. The more economically advanced members and bigger non-member global economies tend to enjoy bigger trade expansion compared to other countries.

Ranilovic (2017) did not find any added value of Croatia entering into Central European Free Trade Agreement (CEFTA) of which Croatia was a member of until 2013 when it joined the EU and hence its membership in CEFTA had ended. One of the reason for the non-added value could be proven strong bias

against countries of former Yugoslavia<sup>5</sup>. Through gravity model she had also found that Croatia's EU membership had affected the trade with EU's member countries positively and that the FTAs signed with EU's non-member countries did not had a significantly positive effect on Croatian trade.

Bergstrand *et al.* (2011) analyzed six EU FTAs: with South Africa (1999), Mexico (2000), Morocco (2000), Tunisia (1998), Chile (2003) and Jordan(2002). Using gravity model he found out that the FTA with Tunisia and Morocco increased EU exports by 80% and that the FTA with Chile increased the EU exports by more than 100%. Besides that, EU imports from Mexico and Chile increased by 50-90%. On contrary, the EU exports to Mexico as well as the EU imports from Tunisia, Morocco and South Africa did not increase significantly. It is due to a long transition period and due to prior trade deals that already eliminated some of the tariff barriers, such as Generalised System of Preferences (GSP).

## 2.5 EU- South Korea FTA analysis

Even though the EU- South Korea FTA came into force only recently, its effects can be already seen since it has been applied provisionally in 2011. Despite this, there is not much ex-post research done about this FTA's effects. As shown in this section of the thesis, vast majority of the research is done by the EU's institutions and they are mostly using descriptive analysis of data from various institutions.

As seen from the Figure 6.1 the growth of the EU's exports as well as imports has been growing. Moreover, the exports from the EU to the South Korea almost doubled from 2010 until 2019.

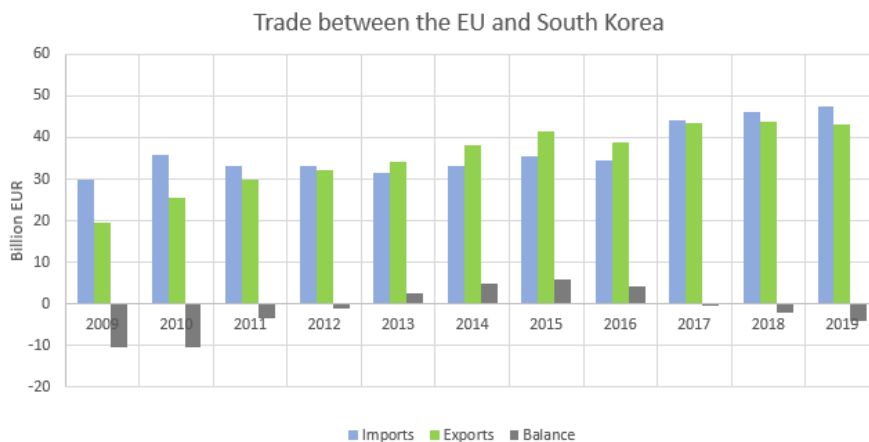
Surprisingly the growth of exports from South Korea to the EU grew less than the exports from the EU to the South Korea. According to Plaisier *et al.* (2018) it is because the EU market was already open to Korea more than the Korean market was opened to the European Union countries. Other researches also evaluate this agreement to be more beneficial for the EU so far (Lakatos & Nilsson (2015), European Commission (2018), Juust *et al.* (2020)). This agreement made South Korea to be the EU's 8th largest trade partner in 2017 and

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<sup>5</sup>As of April 2020 CEFTA members include Albania, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, North Macedonia and Serbia. Meanwhile former Yugoslavia countries are Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia.



Figure 2.1: Trade between the EU and South Korea



*Source:* Eurostat, 2019.

the EU to become South Korea's 4th largest export country in 2017 (Gardoňová & Prno 2017).

European Commission (2018) is probably the most detailed descriptive analysis of the EU - South Korea FTA up to date. Amongst other things it explains the reason behind the FTA having a larger effect on the EU's exports than it has on South Korea's exports. It is due to the fact that before the provisional application of the FTA, South Korea's tariffs were 35% higher on average than EU's tariffs. Hence EU's exports increased by 54% on average while the South Korea's exports increased by 15% on average between 2011 and 2014. It also demonstrated increase in service exports in both parties, small impact on promoting competition in the Korean economy, success in the reduction of non-tariff trade costs and positive influence on the FDI between the two parties.

Lakatos & Nilsson (2015) found positive effect of the FTA on exports of both parties. The exports from the EU to South Korea increased by approximately 10% and the exports from South Korea to the EU increased by 2.2%. By using trade data from period 2005 to 2014 he also found out that the EU exports had increased significantly ever since the negotiations of the FTA started in 2007. He found an asymmetry in the significance of the EU's exports' increase and South Korea's exports' increase since the beginning of the FTA's negotiations. It could be explained by difference in the trade policy environment.

Alessia (2015) researched more effects that could be already seen after the provisional adaptation of the EU- South Korea FTA. EU's trade with Japan,

especially automobiles and electronics industries, has been affected by this FTA as EU increased imports of these goods from Korea. He also predicted that the effect of this FTA is going to have two stages for South Korea. Firstly, Korean large conglomerates, called chaebols (e.g. LG, Samsung) will become even more competitive. Secondly, restructuring of Korean small and medium enterprises is going to be needed so that even these businesses can gain more from the free trade agreements Korean government is providing. These structural changes and gained importance of small and medium companies is then expected to lessen the importance of the EU- South Korea FTA because FTA with other Asian countries might become more important especially for smaller businesses.

Plaisier *et al.* (2018) pointed out some problems that the businesses using the EU- South Korea FTA are facing. According to their research many businesses stated that customs inspections are a big problem. Many of these customs issues are related to consumer electronics that are having issues with the intellectual property and technical requirements. Korean custom offices also try to find reasons why the tariffs should be applied so that they can obtain tariff revenues. The distance between the two parties lead to cultural differences. Asia is known for their strict business culture, etiquette and business protocol that is followed in Asia even nowadays. For businesses not knowing this culture and customs and without the tolerance and will to learn and adapt it might be hard for both parties to do business together. Cultural differences together with the language barrier may lead to the rules' interpretation differences between the two parties.

Korean government's research showed that in 2000s the Korean FTAs were not used well by Korean businesses, especially the small and medium sized businesses. It was mostly due to the rules of origin that were not understood properly. The Korean government utilized several national business supporting agencies to provide various trainings and seminars about the FTA for the businesses. The main agency responsible for promoting FTAs, consulting on FTAs, organizing trainings for businesses etc. is the FTA Promotion and Policy Adjustment Authority (Cheong & Cho 2009).

As mentioned earlier, compared to other regions, East Asia, including South Korea, has been slower in becoming parts of the world trade agreements (Urata & Okabe 2007). It is also crucial to realize that not all the countries of the EU reached the same level of development. The effect of the FTA in general is different for developing and developed countries as was showed in the previ-

ous section and therefore should be considered when evaluating this particular FTA's effects.

The key benefits of the EU- South Korea FTA for the European Union includes (European Commission, 2011):

1. Elimination of tariffs for exports of industrial and agricultural goods from the countries of European Union (the highest impact is expected to be seen in exports of machinery, chemicals, clothing, agricultural products such as pork, whiskey and dairy products),
2. Easier market access of services from the European Union (South Korea will allow EU satellite broadcasters to operate in South Korea, European lawyers to open offices in South Korea, European Union's shipping companies, etc.),
3. Reducing non-tariff barriers in medical and pharmaceutical sectors, as well as in electronics' sector (extra testing and certification procedures will no longer be required),
4. Making it easier for EU car manufacturers to enter the South Korean markets (by eliminating South Korean non-tariff barriers and duties, new dispute settlement mechanism that will decide disputes related to automotive industries unbiasedly, specific Korean standards for car manufacturers does not have to be taken into account anymore by European Union's car companies when they want to advance to the Korean market),
5. Improving the access to government procurement (Built- Operate- transfer contracts),
6. Protection of intellectual property rights (protection for some important European goods, such as Polska Wodka, České pivo etc. is included),
7. Strong competition rules (sanctions to some practices that do not support free competition),
8. Transparency
9. Sustainable development (commitments of companies to environmental standards)
10. Effective dispute settlement

The only ex-post analysis of the EU - South Korea's FTA using the gravity model up to date is the Juust *et al.* (2020)'s research. He analyzed changes in trade flows in the EU- South Korea automotive industry. He found out that the EU's automotive exports had risen by 11% by year 2015 and as well as some other researchers he found out that there was no significant affect on the South Korea's automotive export. He also pointed out the high level of protectionism in the automotive industry even with relatively low levels of tariffs.

Alessia (2015) analyzed also sectoral data of the FTA's effect. According to their research EU also experienced higher growth of exports compared to South Korea. It was due to the fact that protectionism was higher in South Korea. This higher level of protectionism was mostly in sectors with pharmaceutical products, chemicals, machinery, food and other agricultural products. They found out that the largest increase in EU imports was in chemical industry (72%) and of EU exports in transport equipment, such as cars and trucks. They also pointed out that the impact of this agreement on the bilateral service sector is impossible to the service trade data non-availability prior to year 2012. By analyzing individual EU members' exports they also pointed out that the effect of the agreement diverse across industries as well as across different European Union members.

As mentioned earlier, some researches found out consecutive increase in mutual trade of the EU and South Korea even since the start of negotiations. Research using descriptive analysis by Eurostat (2012) was looking at trade between the two parties from 2000 to 2010. In this time period they found a significant increase in trade in all the SITC sections. According to their research, the most significant increase was in Section 3 - Mineral fuels, lubricants and in Section 7- Machinery and transport equipment. Since even before the agreement took place the EU exports were much higher than European Union's imports from South Korea.

FTA is a very important tool for liberalization of the world trade. Researches discussed some of the relationship between FTA and the world trade and also different factors that can be researched about the FTA and its effect on the international trade by using the gravity model approach. As seen from the literature review ex-post analysis of the EU- South Korea FTA is somewhat insufficient.

Therefore the purpose of this research is to find out the effect of the EU-

South Korea FTA on their mutual trade by new approach, using gravity model and therefore expanding on previous, mostly descriptive approaches, and accounting for the product classification over time. The second goal is to point out the differences of the FTA's impact across different industries. These differences are expected to have arisen from different level of protectionism and liberalization in different industries from before the FTA took effect. Finally we want to observe the impact of the FTA on the most discussed automobile and electronics' industry as these two industries were characterized by the highest level of protectionism and took the longest time to negotiate. These points are captured in the following hypothesis:

Hypothesis #1: The EU - South Korea FTA agreement has positively affected their mutual trade.

Hypothesis #2: Not all industries of their mutual trade are impacted by this agreement.

Hypothesis #3: The biggest impact of the FTA can be seen on the most discussed automobile and electronics' industry.

The next section focuses on the main issues when applying a theoretical gravity model.

# Chapter 3

## Gravity Model issues

As mentioned above, gravity models are a very good tool to examine the world trade flows controlling various variables, such as the FTA. Nevertheless they are not perfect and there still does not exist perfect solution for all the most common problems.

As mentioned in the previous section the Gravity with Gravitas model was a pioneering model that solved problems of the intuitive gravity models as it provided the theoretical background as well as the multilateral resistance terms. However, this model is also not without flaws. Baldwin & Taglioni (2006) characterized three main issues of the gravity model- gold, silver and bronze medal errors. Typically in gravity models, proxy variables, such as GDP are transformed into their logarithmic forms and are used as proxies for the MRTs. However, these variables are correlated with the trade costs and their omitting causes biased estimation results. Baldwin & Taglioni (2006) called this common mistake a gold medal mistake. Silver medal mistake is not using unilateral trade flows.<sup>6</sup> Lastly, the bronze medal error is a mistake of using an unsuitable deflation of nominal trade values that is presumably going to lead to a bias through false correlation. The bronze medal error is solved once researchers solve the gold medal error, i.e. by using time dummy variables.

In the following sections the thesis will discuss the most pressing problems of the theoretical gravity models, such as Zero trade flows, Endogeneity and Disaggregated Trade Flows.

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<sup>6</sup>Exports from country  $i$  to a country  $j$  at time  $t$  should be recorded as one observation and exports from country  $j$  to a country  $i$  at time  $t$  as another observation.

### 3.1 Zero trade flows

For the theoretical gravity model researchers should use unilateral trade flows so that the exports from South Korea to the EU and exports from the EU to South Korea are presented separately, i.e. as two single observations at time  $t$ . It is to avoid the Silver medal error mentioned above. Problem of zero trade flows arises depending on the dataset. Some databases do not distinguish between the zero trade flows and missing trade flow. If one is to replace missing observations with zeros, the zero trade flows and missing trade flow are mixed. Several researchers (Haveman & Hummels (2004), Rubinstein *et al.* (2008)) pointed out the problems due to the fact that there are always some observations missing as one country does not trade with every other relevant country of the datasets. This problem becomes more visible the further away the countries of the interest are located from each other since countries closer to each other are more likely to trade together and the more disaggregated dataset a researcher uses. The higher the level of disaggregation of data the higher the risk of zero trade flows. The gravity equation is almost always estimated using data sets converted into log-linear forms and. Hence, these observations get dropped as logarithms of zero are not defined. However, dropping the missing observations causes loss of information and therefore can lead to deceptive results. According to Will & Cong (2015) the zero trade flows' issue used to be ignored because the log-linear function was very convenient and there were no techniques for dealing with the issue. The researchers did not realize the high frequency of such observations and that they do not occur ambiguously. Recent research helped to solve the issue of zero observations in different ways.

One of the simplest solutions is to drop all the zero trade flows. However, this method should be used only if these zeros are missing data or rounding errors. Otherwise the model can lose some important information. If a researcher is not completely sure that the zero trade is some randomly distributed error in the dataset it is not advisable to solve the trade flow issue in this manner.

Another solution is to add a small constant, such as 1, to all of the zero observations. Logarithm of 0 is undefined but logarithm of one is zero. Both of these solutions have to be considered carefully based on the reasons behind these zeros. If the zero observations are kept in the dataset a suitable method to estimate them has to be chosen as an OLS approach would no longer produce consistent estimates. The OLS regression is unbiased if assumptions of linearity, zero conditional mean, conditions of homoskedasticity and random sampling are

fulfilled (Bacchetta *et al.* 2012). However, the condition of homoskedasticity is not fulfilled in the trade data.

Instead of the OLS approach one could use the Tobit estimator (the censored regression model). This model is used when there are zero trade flows in the dataset that might be carrying some important information. Unobservable (censored) observations are recorded as zeros in this model (Linders & Groot 2006).

Santos Silva & Tenreyro (2006) used the PPML estimator that is more sophisticated method than the Tobit estimator. This approach is quite popular amongst researchers because it accounts not only for the zero trade flows but also for the heteroskedasticity in the data. Using this method one can estimate the non-linear form of the dependent variable of the gravity model and hence keep the zero trade flows in the dataset.

## 3.2 Endogeneity

Another common problem of gravity model is endogeneity. This problem usually appears when an explanatory variable is correlated with the error term. It can arise due to a measurement error, autocorrelation, omitted variable bias as well as simultaneity (Raihan 2016). Endogeneity is a common problem that occurs during observations of the FTA effect through gravity model because it is very likely that the countries that enter into the FTA already have some economic or political ties (Baier 2007).

In one of their researches Baier (2007) assumed that the reason for unreliable results so far was the use of a cross-sectional data. They argued that using panel data for the gravity model will yield stable results as they allow to correct for unobserved time-invariant heterogeneity using fixed effects (FE). Even with the FE methodology the time-varying omitted variables are still a problem.

One of the possible solutions for the endogeneity problem is using an instrumental variable (IV) simulation. Baier & Bergstrand (2002) used the instruments related to political factors. However, this instrument variable was correlated with trade flows which resulted in unreliable results. The IV has to be chosen very carefully as the variable cannot be correlated with trade but has to be correlated with the endogenous variable.



One of the common approaches using an IV simulation is the two stage least squares (2SLS) that runs the regression twice or Generalized Method of Moments (GMM) estimation that uses lagged levels as instruments for current differences. However, GMM estimates are usually sensitive to the number of lags used. Neither of these solutions is perfect but without correcting for endogeneity the results of gravity models cannot be reliable (Yotov *et al.* 2016).

### 3.3 Aggregated vs. Disaggregated data

Another dilemma for the researchers using gravity models is whether to use aggregated or disaggregated data. Aggregated data put together data of all the sectors and industries. Pooling all of the sectoral data together leads to a vast information loss. Therefore, a trend of using disaggregated data over aggregated data can be seen in gravity models. According to Yotov *et al.* (2016) disaggregated data can be especially useful when researching the effect of different policies, such as the effect of FTA, across industries as the results are expected to vary.

For better understanding the equation 2.4 using disaggregated data would change to

$$\ln(X_{ij}^s) = \alpha + \beta_1 \ln(GDP_i^s) + \beta_2 \ln(GDP_j^s) + \beta_3 \ln(distance_{ij}^s) + u_{ij}^s \quad (3.1)$$

where  $s$  represents the sector for which each equation is being calculated.

However Bacchetta *et al.* (2012) also pointed out that the use of disaggregated data usually leads to more zero trade flows and it also increases the risk of heteroskedasticity compare to the use of aggregated data. When using aggregated data, it is also advised to analyze disaggregated data and afterwards re-aggregate the results.

There is no general criteria on to what degree the data should be disaggregated. But intuitively the more disaggregated the data are the more challenging it is to work with it. Furthermore, the more serious the already mentioned problems of heteroskedasticity and zero trade flows are.

The disaggregation of the data can be done on several levels. The most detailed one is the dataset using individual commodities. This leads to a very

high number of zero observations and therefore has to be used cautiously. Far more common disaggregation is achieved by using one of the goods classification systems. The most common ones include Standard International Trade Classification (SITC)<sup>7</sup>, Standard Industrial Classification of All Economic Activities (ISIC) and Harmonized System (HS). The more specific ones are North American Industry Classification System (NAICS), Advanced Technology Products (ATP), etc.

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<sup>7</sup>The latest revision is the 4th revision that consist of 10 sections, 67 divisions, 262 groups, 1 023 subgroups and 2 970 basic items.

# Chapter 4

## Data and Methodology

The following chapter will take a closer look on the model and data used in this thesis.

### 4.1 Data

The dataset for a gravity model should not be limited only to the countries the researcher is interested in but it should use maximum information available and therefore add as many countries as possible. The gravity equation can be estimated with cross section data for one year or with panel data for effects over multiple years (Plummer *et al.* 2010).

The thesis uses panel dataset of bilateral trade flows of 169 countries and the information from year 2005 until 2018. This years were chosen to control for the time before the FTA has been signed as well as during and after the process of the FTA taking a full effect.

The dependent variable of our model is  $trade_{ijt}^s$  and it represents the quantity of exports from  $i$  to a country  $j$  during the year  $t$  for the sector  $s$ .  $s$  is based on SITC, a classification of goods that classifies export and import products of a country to allow for a comparison of different countries, years and product categories. The thesis uses SITC revision 2 even though Revision 4 is available since the year 2006. It is due to the fact that Revision 2 data are the most widely available for the model including year 2005. The thesis uses 1-digit level of disaggregated SITC data, i.e. the trade is divided into 10 sections as follows:

1. **Section 0** Food and live animals chiefly for food

2. **Section 1** Beverages and tobacco
3. **Section 2** Crude materials, inedible, except fuels
4. **Section 3** Mineral fuels, lubricants and related materials
5. **Section 4** Animal and vegetable oils, fats and waxes
6. **Section 5** Chemicals and related products, n.e.s.
7. **Section 6** Manufactured goods classified chiefly by material
8. **Section 7** Machinery and transport equipment
9. **Section 8** Miscellaneous manufactured articles
10. **Section 9** Commodities and transactions not classified elsewhere in the SITC

It is measured in USD. The data was collected from the UN Comtrade database.

$GDP_{it}$  and  $GDP_{jt}$  represents the gross domestic product of a country  $i$  and  $j$  in a year  $t$ . It is measured in constant 2010 USD. The sizes of the two economies in gravity models are most commonly measured through the gross domestic product, population or by gross domestic product per capita. These variables might be very highly correlated and therefore only one of them is usually included in the gravity models. The data was collected from World Integrated Trade Solutions (WITS).

$distcap_{ij}$  represents distance between country  $i$  and  $j$ . The distance is assuming the role of the trade's costs and usually it is measured as the distance of the two parties' capital cities as it is assumed that the capital cities are the economic hubs of the respective countries. As this measurement does not take into account that the capital city might not always be the economic center as well or that a country can have more than just one economic center etc. there have been made some other variables. For example, measure of remoteness or the average distance of a country from all the other trade partners. It is also expected that developed countries trade more intensively in comparison with the small countries because they are more inclined towards innovation, better infrastructure that makes trading easier, more liberal trade policy etc. (Wal,

2006). For the purpose of this thesis the distance between the two countries' capitals has been chosen. The data was collected from CEPII.

$FTA_{ijt}$  is a dummy variable which takes a value 1 if the countries  $i$  and  $j$  are members of the EU- South Korea FTA in year  $t$  and a value 0 if they are not. As mentioned in Chapter 2 the EU- South Korea FTA was provisionally applied in 2011 and therefore this variable will take a value 1 since this year. The only exception is Croatia that entered into the EU in 2013 and therefore it will take value 1 only since the year 2013 <sup>8</sup>

Following dummy variables have been chosen to represent other ties between countries  $i$  and  $j$  in a year  $t$ :

$border_{ij}$  is a dummy variable which takes a value 1 if the countries  $i$  and  $j$  share a border and a value 0 if they do not. The data was collected from CEPII.

$comlang\_of f_{ij}$  is a dummy variable which takes a value 1 if the countries  $i$  and  $j$  share a common official language and a value 0 if they do not. The data was collected from CEPII.

$colony_{ij}$  is a dummy variable which takes a value 1 if the countries  $i$  and  $j$  ever had a colonial link and a value 0 if they did not. The data was collected from CEPII.

$smctry_{ij}$  is a dummy variable which takes a value 1 if the countries  $i$  and  $j$  have been a part of a same country at any point in the past and a value 0 if they did not. The data was collected from CEPII.

## 4.2 Methodology

The model of the thesis is as follows:

$$\ln(trade_{ijt}^s) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 \ln(distcap_{ij}) + \beta_4(border_{ij}) + \beta_5(FTA_{ijt}) + \beta_6(comlang\_of f_{ij}) + \beta_7(colony_{ij}) + \beta_8(smctry_{ij}) + u_{ij}^s \quad (4.1)$$

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<sup>8</sup>The list of current EU countries in an alphabetical order is Austria, Belgium, Bulgaria, Croatia (since 2013), Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

where  $i$  represents exporter's country,  $j$  represents importer's country,  $t$  represents time and  $s$  represents economic sector according to SITC.  $u_{ij}^s$  represents error term.

$\beta_1$  and  $\beta_2$  are expected to have a positive sign as it is expected that bigger the size of countries' economy the bigger the trade value as well.

$\beta_3$  is expected to have a negative sign as it is expected that the bigger the distance between countries  $i$  and  $j$  the smaller the trade between the two countries due to transportation costs, various logistic difficulties etc.

$\beta_4$  is expected to have a positive sign as it is expected that if countries  $i$  and  $j$  share the same border, i.e. the closer they are, the more they trade together.

$\beta_5$  is expected to have a positive as well as negative signs dependent on the sector  $s$ . Concerning the disaggregated data it is one of the main assumption of the thesis that the EU- South Korea FTA overall positively impacted export between the two parties in all the industries.

$\beta_6$  is expected to have a positive sign as it is expected that if countries  $i$  and  $j$  share the same official language, i.e. the closer they are, the more they trade together as they do not face a language barrier.

$\beta_7$  is expected to have a positive sign as it is expected that if countries  $i$  and  $j$  were members of the same colony at any point in the history, i.e. the closer they are, the more they trade together.

And finally,  $\beta_8$  is also expected to have a positive sign as in the previous case. If countries  $i$  and  $j$  had a same colonizer at any point in the history, the more they trade together.

In the analysis the thesis uses OLS and PPML regressions. Through comparisons of the results of these two models we could see how the results change if we include zero trade flows and account for heteroskedasticity in the PPML model as mentioned in the previous section.

# Chapter 5

## Estimation results

This chapter will provide the results of applied regressions on disaggregated commodity sections. The dependent variable of our model is trade value.

Table 5.1: Summary of chosen variables

SITC category	R <sup>2</sup> of OLS	R <sup>2</sup> of PPML	FTA(PPML regression)
SITC 0	0.3899	0.4486	0.5086
SITC 1	0.3071	0.4152	0.6349
SITC 2	0.4356	0.5263	0.1862
SITC 3	0.2897	0.3738	0.075
SITC 4	0.1969	0.3039	0.138
SITC 5	0.544	0.667	0.8092
SITC 6	0.569	0.689	0.4423
SITC 7	0.596	0.699	0.5838
SITC 8	0.569	0.687	0.6045
SITC 9	0.46	0.572	-0.29

*Source:* Author's analysis

According to Table 5.1 we can see that the explanatory variables explain 30% to 70% of trade values in any of the commodity categories using the PPML regression and only 20% to 60% using the OLS method. Hence, as expected the results suggest that the PPML estimation has higher explanatory power. It is mostly due to the fact that it includes also zero observations and accounts for heteroskedasticity. In some cases, including zero trade flows doubled the number of observations included in the model which resulted in the higher explanatory power. Logically, the more disaggregated the data the more zero trade flows it contains. These results also suggest that more variables could

have been included in the model especially for some categories, such as category of Mineral fuels, lubricants and related materials and category of Animal and vegetable oils, fats and waxes. It seems that these two sections are not well suited for our gravity model. Some of the suggested dummy variable that could help to explain trade in more precise way are country's openness, risk, membership in institutions, such as WTO, tc., landlocked, colonizer, etc.

In the third column we can see the most important dummy variable of the model - *FTA*. The *FTA* coefficients of the OLS method can be see in detailed results but using this method the FTA proved to have much smaller effect. Nevertheless, in both cases and as expected the FTA increased mutual trade between countries of the European Union and South Korea. For the PPML regression it increased in every commodity category except of the Commodities and transactions not classified elsewhere in the SITC. It was also expected that the trade is not going to increase by the same amount across all the industries. This is due to the fact that there was a different level of protectionism across industries.

Following sections contain detailed overview of results divided by SITC categories.

## 5.1 Food and live animals chiefly for food

$R^2$  is equal to 0.44 which means that the explanatory variables explain more than 44% of the trade values. For comparison using the OLS method  $R^2$  was smaller which indicates that the PPML model is better suited for the analysis. As the PPML method also provides robust estimates even under heteroscedasticity and fixed effects and also includes zero observations, the thesis will interpret those results in more detail. The F statistic is measuring the overall significance of regression. As the p-value is almost always equal to 0 it means that the regression overall is making sense. In this thesis, we test the hypothesis at the 5% level of significance, and therefore we will consider as statistically significant variables (i.e. variables that have a statistically significant effect on trade value) that are marked at least with two \*. For the Food and live animals chiefly for food category all of the explanatory variables are statistically significant except of the variable *comlang off*. This apply for the OLS estimator as well as for the PPML estimator with just a different coefficient.

Increasing the exporter's GDP by 1% will increase trade by about 0.65 %.



Table 5.2: Section 0- Food and live animals chiefly for food - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-0,95524*** (0,00859)	-0,672*** (0,009)
log(GDP Reporter)	0,8699*** (0,0035)	0,6538*** (0,0027)
log(GDP Partner)	0,66502*** (0,0031)	0,5943*** (0,0030)
comlang off	0,6631 (0,0198)	-0,2381 (0,01918)
colony	1,1107*** (0,0448)	0,2503*** (0,03)
smctry	1,0551*** (0,0583)	-0,7055*** (0,0377)
FTA	0,1370*** (0,0602)	0,5086*** (0,0164)
border	1,4129+*** (0,0427)	1,666*** (0,02258)
Constant	-16,9872*** (0,1445)	22,55*** (0,0743)
R <sup>2</sup>	0,3899	0.4486

*Source:* Author's analysis

An increase in the importer's GDP by 1 % will increase trade by approximately 0.59 %. As expected the distance have a negative effect on trade and 1% increase in distance will reduce trade by 0.67 %. Interpretations of dummy variables differ slightly. Countries that have had colonial connections in the past trade 28 % more as the ones without a colonial connection. Interestingly the model showed that countries that were part of the same country trade 50% less than others. Countries that share common borders trade four times more than those that do not. The EU - South Korea FTA increased trade in food and live animals chiefly for food category by 66 %.

## 5.2 Beverages and tobacco

The same as for the category SITC 0 R<sup>2</sup> is higher for the PPML method. It's the third lowest R<sup>2</sup> in all the sections. For the Beverages and tobacco category

Table 5.3: Section 1- Beverages and tobacco - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1.0841*** (0,0105)	-0,786*** (0,0122)
log(GDP Reporter)	0,7825*** (0,0046)	0,6765*** (0,0031)
log(GDP Partner)	0,4723*** (0,0040)	0,4687*** (0,0033)
comlang off	0,8161*** (0,0254)	-0,0869*** (0,0257)
colony	1,1594*** (0,0497)	0,858*** (0,03)
smctry	0.7302*** (0,0676)	-0,6432*** (0,0505)
FTA	0,1732*** (0,0196)	0,6349*** (0,0223)
border	0.9421*** (0,0479)	0.6349*** (0,0223)
Constant	-11.1048*** (0,1811)	21.66*** (0,0975)
R <sup>2</sup>	0,3071	0,4152

*Source:* Author's analysis

all of the explanatory variables are statistically significant and as the p-value is almost always equal to 0 it means that the again regression overall is making sense. As expected for gravity models, GDP of exporting country as well as GDP of importing country have a positive effect on the trade and the bigger the distance between trading countries the lower their mutual trade. Interpretations of dummy variables again differ slightly. Interestingly the variable of common official language has a negative effect on countries' mutual trade and same as in the previous category countries that were a part of same country seems to trade less. The EU - South Korea FTA increased trade of beverages and tobacco between these countries by 88 %.

### 5.3 Crude materials, inedible, except fuels

For the Crude materials, inedible, except fuel category all of the explanatory variables are statistically significant and the R<sup>2</sup> for the PPML regression is over

Table 5.4: Section 2 - Crude materials, inedible, except fuels - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-0,9846*** (0,009)	-1,649*** (0,0208)
log(GDP Reporter)	0,8924*** (0,0038)	0,6987*** (0,0030)
log(GDP Partner)	0,9543*** (0,0036)	0,8762*** (0,0037)
comlang off	0,6367*** (0,021)	-0,5698*** (0,027)
colony	0,6717*** (0,047)	0,2825*** (0,065)
smctry	1,166*** (0,062)	-0,3092** (0,095)
FTA	-0,0049 (0,017)	0,1862*** (0,035)
border	1,5111*** (0,044)	2,058*** (0,050)
Constant	-26,139*** (0,1611)	18,07*** (0,179)
R <sup>2</sup>	0,4356	0,5263

*Source:* Author's analysis

0.5. As expected for gravity models GDP of exporting country as well as GDP of importing country have a positive effect on the trade and the bigger the distance between trading countries the lower their mutual trade. Interpretations of dummy variables again differ slightly. Similarly, to other categories the variable of common official language and the variable of same country has a negative effect on countries' mutual trade. Supporting the negative sign of the distance variable if the countries share the same border, they are six times more likely to trade together than if they do not share a border and therefore the distance between them is bigger. The EU - South Korea FTA increased trade of crude materials, inedible, except fuel between these countries by 20 %.

Table 5.5: Section 3- Mineral fuels, lubricants and related materials - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,529*** (0,014)	-0,593*** (0,021)
log(GDP Reporter)	0,930*** (0,0149)	0,917*** (0,0129)
log(GDP Partner)	0,688*** (0,0054)	0,618*** (0,0051)
comlang off	0,422*** (0,036)	-0,0869* (0,0072)
colony	0,606*** (0,068)	0,1872** (0,072)
smctry	0,5376*** (0,087)	-0,7713*** (0,093)
FTA	-0,46*** (0,027)	0,075 (0,041)
border	1,6414*** (0,044)	1,22*** (0,054)
Constant	-15,96*** (0,25)	23,15*** (0,17)
R <sup>2</sup>	0,2897	0,3738

*Source:* Author's analysis

## 5.4 Mineral fuels, lubricants and related materials

In this commodity section the R<sup>2</sup> is second lowest from all the regressions, which means the variables explain only around 37% of trade value between the EU and South Korea in SITC 3 category. Similarly to other categories the variable of common official language and the variable of same country has a negative effect on countries' mutual trade. Supporting the negative sign of the distance variable, the countries that share the same border are twice that likely to trade together than if they do not share a border and therefore the distance between them is bigger. The EU - South Korea FTA increased trade of mineral fuels, lubricants and related materials between these countries by 7 % but in this case the FTA variable is not statistically significant.

## 5.5 Animal and vegetable oils, fats and waxes

Table 5.6: Section 4 - Animal and vegetable oils, fats and waxes - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-0,6424*** (0,0139)	-0,124*** (0,034)
log(GDP Reporter)	0,646*** (0,006)	0,632*** (0,0056)
log(GDP Partner)	0,479*** (0,0057)	0,437*** (0,0058)
comlang off	0,038 (0,033)	-0,4611*** (0,008)
colony	0,552*** (0,059)	0,148 (0,1233)
smctry	0,411*** (0,080)	-0,637*** (0,174)
FTA	0,55*** (0,027)	0,138* (0,068)
border	1,989*** (0,056)	1,46*** (0,095)
Constant	-11,90*** (0,25)	17,23*** (0,29)
R <sup>2</sup>	0,1969	0,3039

*Source:* Author's analysis

The variable FTA is only significant at 10% , not at 5%, and therefore we will not consider it as statistically significant variable. The explanatory variables explain just over 30% of the trade values and the regression has the lowest explanatory powers from all 10 SITC categories for the OLS as well as the PPML method. Similarly to all the other categories the variable of common official language and the variable of same country has a negative effect on countries' mutual trade. Supporting the negative sign of the distance variable if the countries share the same border, they are three times that likely to trade together than if they do not share a border and therefore the distance between them is bigger. The EU - South Korea FTA increased trade of animal and vegetable oils, fats and waxes between these countries by almost 15 % but as

mentioned earlier in this case the FTA variable is not statistically significant at the 5 % level.

## 5.6 Chemicals and related products, n.e.s.

Table 5.7: Section 5- Chemicals and related products, n.e.s. - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,5483*** (0,008)	-0,883*** (0,0085)
log(GDP Reporter)	1,3658*** (0,0037)	0,938*** (0,0028)
log(GDP Partner)	0,7936*** (0,0031)	0,582*** (0,0018)
comlang off	0,9159*** (0,033)	-0,1428 (0,0018)
colony	0,3276*** (0,044)	0,281*** (0,003)
smctry	1,077*** (0,058)	-0,832*** (0,135)
FTA	0,12*** (0,015)	0,8092*** (0,0156)
border	0,614*** (0,042)	1,13*** (0,0219)
Constant	-11,90*** (0,25)	17,23*** (0,29)
R <sup>2</sup>	0,544	0,667

*Source:* Author's analysis

R<sup>2</sup> is equal to 0.66 which means that the explanatory variables explain more than 66% of the trade values, which is the second highest explanatory power. For comparison using the OLS method R<sup>2</sup> is smaller which again indicates that the PPML model is better suited for the analysis. Both regressions are also making sense as the p-value is almost always equal to zero in both cases. The only non-significant dummy variable in the PPML method is the common language variable. Similarly to all the other categories the variable of common official language and the variable of same country has a negative effect on countries' mutual trade and the same border variable suggests that countries

with the shared borders are twice as likely to trade together than if they do not share a border and therefore the distance between them is bigger. The EU - South Korea FTA increased trade of chemicals and related products, n.e.s. between these countries by almost 124 % which is the highest effect amongst the categories.

## 5.7 Manufactured goods classified chiefly by material

Table 5.8: Section 6 - Manufactured goods classified chiefly by materials - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,555*** (0,008)	-0,752*** (0,0085)
log(GDP Reporter)	1,38*** (0,0036)	0,978*** (0,0021)
log(GDP Partner)	0,8416*** (0,0031)	0,698*** (0,0019)
comlang off	0,833*** (0,019)	-0,298*** (0,0204)
colony	0,5399*** (0,047)	0,2643*** (0,0036)
smctry	1,25*** (0,059)	-0,3079*** (0,037)
FTA	0,09*** (0,015)	0,4423*** (0,01787)
border	0,948*** (0,043)	1,46*** (0,023)
Constant	-29,80*** (0,14)	23,83*** (0,07)
R <sup>2</sup>	0,569	0,689
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	

*Source:* Author's analysis

R<sup>2</sup> is equal to 0.69 which means that the explanatory variables explain almost 69% of the trade values, which is the second highest explanatory power. All of the variables in this case are significant. Similarly to all the other categories the variable of common official language and the variable of same country

has a negative effect on countries' mutual trade and the same border variable suggests that countries with the shared borders are twice as likely to trade together than if they do not share a border and therefore the distance between them is bigger. The EU - South Korea FTA increased trade of manufactured goods classified chiefly by materials between these countries by almost 56 %.

## 5.8 Machinery and transport equipment

Table 5.9: Section 7 - Machinery and transport equipment - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,37*** (0,008)	-0,582*** (0,0103)
log(GDP Reporter)	1,49*** (0,0035)	1,18*** (0,0029)
log(GDP Partner)	0,7563*** (0,0030)	0,702*** (0,0017)
comlang off	0,804*** (0,019)	-0,347*** (0,021)
colony	0,768*** (0,046)	0,1251** (0,0039)
smctry	1,05*** (0,058)	0,69*** (0,031)
FTA	0,46*** (0,015)	0,5838*** (0,018)
border	0,691*** (0,04)	1,715*** (0,025)
Constant	-31,83*** (0,14)	23,09*** (0,086)
R <sup>2</sup>	0,596	0,699

*Source:* Author's analysis

R<sup>2</sup> is equal to 0.699 which means that the explanatory variables explain almost 70% of the trade values, which is the highest explanatory power of all the sections *s*. This regression is also making sense as the p-value is almost always equal to zero. All of the variables in this case are significant and the same country variable finally has expected positive effect on countries' mutual trade. As in all the other cases the variable of shared language between countries



seems to have a negative effect on their trade. The EU - South Korea FTA increased trade of machinery and transport equipment between these countries by 79 %.

## 5.9 Miscellaneous manufactured articles

Table 5.10: Section 8- Miscellaneous manufactured articles - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,38*** (0,008)	-0,611*** (0,0103)
log(GDP Reporter)	1,31*** (0,0034)	1,23*** (0,0027)
log(GDP Partner)	0,822*** (0,0030)	0,687*** (0,0015)
comlang off	0,97*** (0,019)	-0,2755*** (0,021)
colony	0,968*** (0,047)	0,1235** (0,0038)
smctry	1,18*** (0,059)	0,411*** (0,037)
FTA	0,379*** (0,015)	0,6045*** (0,02)
border	0,712*** (0,04)	1,517*** (0,027)
Constant	-29,76*** (0,14)	22,26*** (0,09)
R <sup>2</sup>	0,569	0,687

*Source:* Author's analysis

All of the variables of this model are significant at 1%, and therefore all of the variables are statistically significant. The explanatory variables explain just over 68% of the trade values and the PPML method has higher explanatory powers than the OLS method. Likewise, to all the other categories the variable of common official language has a negative effect on countries' mutual trade. Supporting the negative sign of the distance variable if the countries share the same border, they are more than three times that likely to trade together than if they do not share a border and therefore the distance between them is bigger.

The EU - South Korea FTA increased trade of miscellaneous manufactured articles between these countries by 83 %.

## 5.10 Commodities and transactions not classified elsewhere in the SITC

Table 5.11: Section 9 - Commodities and transactions not classified elsewhere in the SITC - Results Overview

	<i>Dependent variable:</i>	
	Trade Value	
	(OLS)	(PPML)
log(distcap)	-1,20*** (0,012)	-0,595*** (0,029)
log(GDP Reporter)	1,09*** (0,005)	0,98*** (0,003)
log(GDP Partner)	0,72*** (0,004)	0,66*** (0,002)
comlang off	0,93*** (0,027)	0,124* (0,05)
colony	1,16*** (0,05)	0,825*** (0,0077)
smctry	-0,519*** (0,059)	-0,222 (0,037)
FTA	-0,17*** (0,022)	-0,29*** (0,06)
border	0,08 (0,05)	1,18 (0,007)
Constant	-24,96*** (0,21)	21,96*** (0,024)
R <sup>2</sup>	0,46	0,572

*Source:* Author's analysis

Last commodity model has three non-significant variables- same country, shared border and common language which is significant only at 10% level. The explanatory variables explain just over 57% of the trade values and the PPML method has higher explanatory powers than the OLS method. As the p-value is almost always very close to 0 it means that the regression overall is making sense. This is the only commodity category in which the EU - South Korea FTA seems to have a negative effect on their trade. The FTA decreased

their mutual trade by 25%. It is also only one of the few categories for which shared language has a positive impact on countries' mutual trade.

# Chapter 6

## Discussion of results

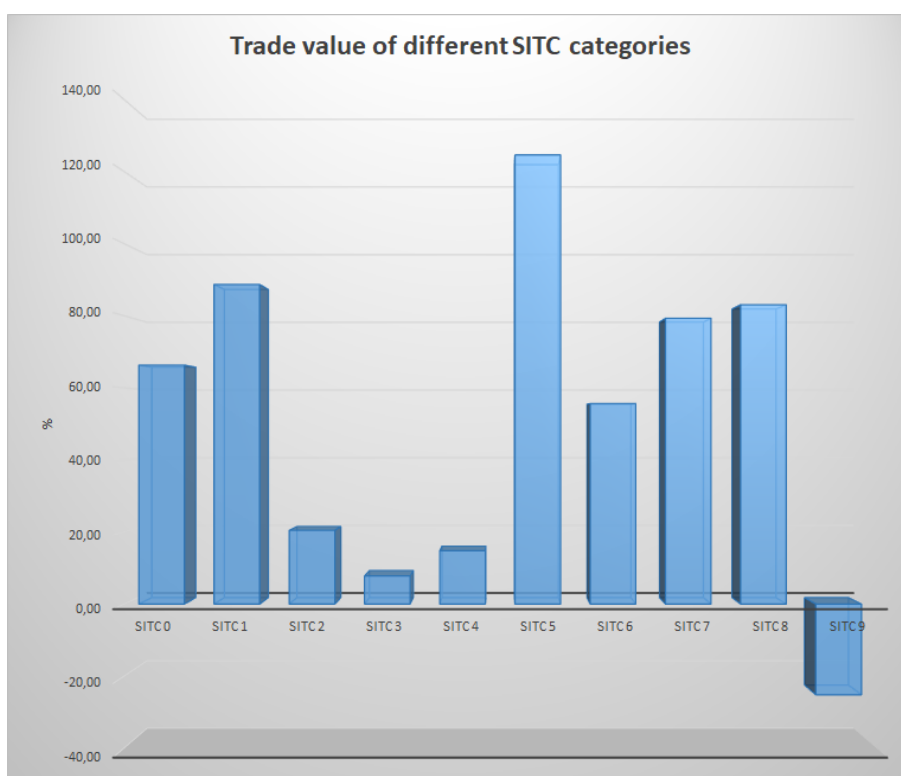
In this chapter we describe implications of results of the regressions on our gravity model as well as on the three hypotheses on the disaggregated data. Firstly, based on our regressions we can draw conclusion of the variables influence on trade in general. As expected in gravity models, the GDPs have positive effect on trade, i.e. the higher the GDP of trading countries the more they trade together. The same goes for expected negative sign of the variable *od distance*. The farther away the countries are from one another the less they trade together as it requires larger transaction costs, etc. Variable *border* is closely related to the logic of distance variable. If trading countries share a border that implicates that the distance is minimal. This coefficient was positive and statistically significant in all trade categories. If two countries share a colonial past together that leads to other similarities, such as shared language, that was expected to lead to a positive effect on trade. However, in our model shared language had a negative effect on bilateral trade in all trade sections, except of section 9. Similarly, our regression yielded unexpected results in *smc-country* category. It was expected that if some countries used to be a same country (which suggests same or at least similar common language, proximity of countries, etc.) They will have good relations and trade more. However that was not the case in our analysis, except of Sections 7 and 8.

In the Hypothesis #1 we claimed that the EU - South Korea FTA agreement has positively affected their mutual trade. Based on disaggregated data we can see that that the FTA had a positive effect on the EU - South Korea's mutual trade in all the categories except of the last category SITC 9 - Commodities and transaction not classified elsewhere in the SITC. However the *FTA* variable was not significant in two of the categories. We tested only for disaggregated

data but for the future research it would be interesting to see the effects on the aggregated data as well. To conclude, in 9 cases out of 10 we do not reject the hypothesis but for the SITC 9 we reject it.

The Hypothesis #2 claimed that not all industries of their mutual trade are impacted by this agreement. As seen from the Figure 6.1 all of the industries are impacted by this agreement. However, all of the industries are impacted differently. For example, the Section 5- Chemicals and related products, n.e.s. registered the highest growth thanks to the free trade agreement. On contrary Section9 - Commodities and transactions not classified elsewhere in the SITC experienced decrease in trade. Hence, we are rejecting the Hypothesis #2. It is supported by the fact that the agreement decreased tariffs in all the industries and therefore should also affect them.

Figure 6.1: Trade value of different SITC categories



Source: Author's computation.

Lastly the Hypothesis #3 claimed that the biggest impact of the FTA can be seen on the most discussed automobile and electronics' industry. As seen from the Figure 6.1 the biggest impact can be seen on the Section 5- Chemicals and

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related products, n.e.s., followed by Section 1 - Beverages and tobacco, Section 8- Miscellaneous manufactured articles and Section 7- Machinery and transport equipment. Automobile and electronics industry is included in Section 7 and therefore we found out that it is experiencing the 4th largest growth in trade. This might be caused by the fact that the automobile and electronics industry's transition to free trade is slower compared to other industries because the level of protection at the beginning was one of the highest. Hence, we also reject the hypothesis #3. The effect might change in the future, as some tariffs are going to be completely removed only in 2032.

# Chapter 7

## Conclusion

The main goal of the thesis was to analyze the effect of the EU- South Korea FTA on their mutual trade. The importance of the bilateral trade agreements had been growing in the world trade ever since Doha Development Round reached its stalemate and negotiations were not successfully started again. As many others, the European Union and South Korea started looking for different solutions to support their economy and their trade with other countries. Therefore, they started negotiations about signing the Free Trade agreement in 2007. For both of the countries it was quite a groundbreaking and very extensive agreement that included gradually removing tariff barriers to their mutual trade as well as non-tariff barriers to trade in products and in services.

This thesis uses gravity model on a disaggregated dataset of the world trade in 10 sections of trade between years 2005 and 2018. For comparison the thesis uses OLS as well as the PPML method to compare the results. It was proven by Santos Silva & Tenreyro (2006) that the PPML is a better suited estimator for the trade data as it accounts for heteroskedasticity and zero trade flows that are especially important in disaggregated data. We confirmed his findings as the PPML regression yielded better results than the OLS regression.

As confirmed by this thesis, even though the FTA took effect only in December 2015, its effect on their mutual trade is already very big. The exports from the EU to South Korea grew by more than 10% since it was provisionally applied and the exports from Korea to the EU also grew but at slower rate. This thesis confirmed these results on disaggregated data.

Observing for the sectoral effect of the FTA we found out that its effect varies across the industries. In 90% of sections the effect was positive however

in 1 section - section 9 Commodities and transactions not classified elsewhere in the SITC- our model showed negative effects of the FTA. In two commodity sections we also observed that the FTA variable is not significant. The thesis found out that the biggest positive influence of removing trade barriers between countries was in SITC 5 - Chemicals and related products, n.e.s. category. This might be due to several reasons, such as the highest tariff as well as non-tariff barriers to trade before the implementation of FTA. This category is also quite specific and the FTA not only eliminated tariffs across industries but also united some specific medical, chemical, etc. standards.

Further research opportunities could be to include other explanatory variables to the model as including our variables resulted in them explaining 30-70% of trade, dependent on different category. Another possible expansion would be to include more years prior to 2005 as it was suggested in other researches that the trade between the EU and South Korea started to increase since 2007 when the negotiations of the FTA started. And lastly this thesis used 10 sections of the SITC and it would be interesting to use the gravity model for groups, subgroups or even basic items to find more specific effects on different items over the years.



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