CHARLES UNIVERSITY
FACULTY OF SOCIAL SCIENCES
Institute of Economic Studies

Analysis of the effects of EU membership on trade flows of member countries. Implications for new members and for attempts to leave the EU

Bachelor's thesis

Author: **Timur Bahodirovich Barotov**
Study program: **Economic Theories and Finance**
Supervisor: **Vilem Semerák, Ph.D.**
Year of defense: **2020**

Declaration of Authorship

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Prague, July 31, 2020

Timur Barotov

Abstract

This thesis provides an answer on a question whether does a country benefit from being a member of European Union from an international trade flows perspective. For estimation purposes, the data set was constructed of 195 nations listed in the appendix, for period 1988 to 2018. Gravity model was employed in the estimation process with accordance to the newest estimation standards, where the two methods employed in this thesis are Fixed Effects model as in most similarly oriented papers and Poisson Pseudo-Maximum-Likelihood to account for any possible biases caused by zero observations. Main theoretical concept for estimating EU effect is Viner's trade diversion and trade creation effects. Moreover, the thesis gives a hint on whether the benefits of participating in European Union are immediate or are expected to increase with a time in the advanced stages of integration. The results of this study show statistically significant and positive effect of EU membership on nation's international trade flows, yielded both by Fixed Effects and Poisson Pseudo-Maximum-Likelihood models. Interestingly, the EU effect proved to be favouring more exporting nations than importing ones. Results also provided evidence of trade creation due to EU membership. Additionally, the results suggest that aforementioned integration benefits are indeed growing with the time and it is not one-off process. Specifically, after five years threshold the benefits of integration were still present.

JEL Classification	F10, F13, F14, F15, F40, F50, F55
Keywords	EU, FTA, CU, Trade Diversion, Trade Flows, OLS, Panel Data, Gravity Model, Integration
Title	Analysis of the effects of EU membership on trade flows of member countries. Implications for new members and for attempts to leave the EU

Author's e-mail	`tbarotov8@seznam.cz`
Supervisor's e-mail	`vilem.semerak@fsv.cuni.cz`

Abstrakt

Tato práce si klade za cíl odpovědět na otázku, zda členské země skutečně mají prospěch z hlediska mezinárodního obchodu ze členství v Evropské Unií. Za tímto účelem byla použita data pro 195 zemí, jež jsou zmíněny v příloze v časovém období od roku 1988 po rok 2018. Hlavním nástrojem pro regresní analýzu byl zvolen Gravitační model s ohledem na nejnovější empirické poznatky. Mezi užité metody patří: country-pair fixed effects, jež se objevuje ve většině podobných prací a Poisson Pseudo-Maximum-Likelihood, aby se předešlo chybě v důsledku zanedbání chybejicích obchodních dat, při předešlé metodě. Hlavním teoretickým nástrojem se jeví Vinerův vznik a diverzifikace obchodu. Navíc, výsledky této práce prozrazují zda integrační benefity Evropské Unie jsou z pohledu času okamžité, nebo prodlené. Výsledky regresní analýzy ukazují, že členství v Evropské Unií skutečně pozitivně stimuluje vnik mezinárodního obchodu v členských zemích. Dále se ukazuje, že integrace je vzkutku dlouhý proces a všechny benefity z členství EU se neprojeví hned po vstupu do unie, ale postupně s časem.

JEL Klasifickace	F10, F13, F14, F15, F40, F50, F55
Klíčová slova	EU, Oblast Volného Obchodu, Celní Unie, Diverzifikace Obchodu, Vznik Obchodu, OLS, Panelová Data, Gravitační Model, Integrace
Název	Analysis of the effects of EU membership on trade flows of member countries. Implications for new members and for attempts to leave the EU
Autorův e-mail	`tbarotov8@seznam.cz`
Dohlížitelův e-mail	`vilem.semerak@fsv.cuni.cz`

Acknowledgments

The author is grateful especially to **Vilem Semerák, Ph.D.**for his priceless guidance and **RNDr. Michal Červinka, Ph.D.** for his technical support with latex. And lastly I would like to thank my dear family for supporting me during COVID-19 crisis.

Typeset in FSV LaTeX template with great thanks to prof. Zuzana Havrankova and prof. Tomas Havranek of Institute of Economic Studies, Faculty of Social Sciences, Charles University.

Bibliographic Record
Barotov, Timur: *Analysis of the effects of EU membership on trade flows of member countries. Implications for new members and for attempts to leave the EU*. Bachelor's thesis. Charles University, Faculty of Social Sciences, Institute of Economic Studies, Prague. **2020**, pages 78. Advisor: **Vilem Semerák, Ph.D.**

Contents

Acronyms

AEC African Economic Community

ANZCER Australia-New Zeland Closer Economic Relations

ASEAN Association of South East Asian Nations

BAFTA Baltic Free Trade Agreement

BV-OLS Bonus Vetus Ordinary Least Squares

CEFTA Central Europe Free Trade Agreement

CEMAC Economic and Monetary Community of Central Africa

CES Constant Elasticity of Substitution

CMEA Council for Mutual Economic Assistance

COMESA Common Market for Eastern and Southern Africa

CU Customs Union

DDM Double Demeaning

EAC East African Community

EAEU Eurasian Economic Union

EC European Community

ECCAS Economic Community of Central Asian States

ECOWAS Economic Community of West African States

ECSC European Coal and Steal Community

EEC European Economic Community

EFTA European Free Trade Association

EIA Economically Integrated Agreement

EMU European Monetary Union

EU European Union

FDI Foreign Direct Investment

FE Fixed Effects

FTA Free Trade Area

GATT General Agreement on Tariffs and Trade

GDP Gross Domestic Product

GMM Generalized Method of Moments

GPML Gamma Pseudo Maximum Likelihood

IV Intrumental Variable

LAFTA Latin American Free Trade Association

MERCOSUR Mercado Común del Sur

MR Multi Lateral Resistance

MRT Multi Lateral Resistance Terms

MU Monetary Union

NAFTA North American Free Trade Agreement

NBER National Bureau of Economic Research

NBPML Negative Binomial Pseudo Maximum Likelihood

NLLS Non-Linear Least Squares

NTM Non-Tariff Measure

OECD Organisation for Economic Co-operation and Development

OLS Ordinary Least Squares

PPC Production Possibility Curve

PPML Poisson Pseudo-Maximum Likelihood

PTA Preferential Trade Agreement

RTA Regional Trade Agreement

SACU Souther African Customs Union

SILS Structural Iterated Least Squares

UNCTAD United Nations Conference on Trade and Development

UK United Kingdom

WAEMU West African Economic and Monetary Union

WTO World Trade Organisation

ZI-NB Zero Inflated Negative Binomial

2SLS Two Stage Least Squares

Bachelor's Thesis Proposal

Author	**Timur Bahodirovich Barotov**
Supervisor	**Vilem Semerák, Ph.D.**
Proposed topic	Analysis of the effects of EU membership on trade flows of member countries. Implications for new members and for attempts to leave the EU

Motivation The main research question I intend to study is how EU membership affects the trade flows of countries. Thus, hopefully stating whether it is, or it is not beneficial to join EU from the trade flows point of view. The paper will be based on the application of gravity models, by means of which I will estimate the trade creation and trade diversion effects. Subsequently, I will use these effects as the basis for predictions of the effects of EU integration on the future members (or EU disintegration on selected current members). A similar methodology was used (besides other papers) also in official attempts to evaluate future effects of Brexit on British external trade. The importance of this topic is highlighted in the recent years due to the political state of affairs. Recently United Kingdom voted on leaving the European Union. How is it going to affect both European Union and United Kingdom from the trade flows standpoint? There are oposers to the EU membership - can we also find a relevant argument for leaving the European Union? There are countries attempting to join the European Union - Ukraine or Turkey or Balkan states. What will be the implication of membership in the Union for these countries? It is crucial for future attempts to leave or join the European Union to carefully formulate arguments for and against such an action. In this paper I will attempt to provide with some relevant pros and cons from the trade point of view based on empirical research from the past using both econometric methods and related theoretical background.

Hypotheses

1. Hypothesis: EU membership positively influences trade flows amongst its members

2. Hypothesis: EU positive integration effects on trade are not immediate, but rather increase accordingly with the time spent in EU

Methodology I use R software to conduct econometric analysis with datasets from international databases such as World Integrated Trade Solution (WITS), where I use comtrade data and Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) data. For econometric analysis I found it most appropriate to use gravity model as it is most elegant one and very frequently used by economists to conduct analysis on international economics. Firstly, I intend to cover the theoretical necessary part for the development of my analysis based on classical economic approach. Shortly introducing the gravity model and lastly conducting empirical analysis based on modern specification gravity models, where I will try to avoid frequent mistakes present in other papers as mentioned in Gravity for Dummies and Dummies for Gravity Equations, by Baldwin & Taglioni (2006). Another issue to consider when conducting such paper is the endogeneity of FTAs (which EU essentially is), and how this endogenous character of FTAs influences the gravity model results as is mentioned for example in paper On the Endogeneity of International Trade Flows and Free Trade Agreements, authored by Scott L. Baier, Jeffrey H. Bergstrand (2002). To make the paper more practically-oriented I shall include both overall gravity model and apply gravity model for the most interesting commodities in the respective economies after joining or leaving the European Union. If possible, I will take into consideration the data on services trade flow. Today services are becoming increasingly important in trade between developed countries.

Expected Contribution One similar study was made by Maurice.J.G.Bun and Franc Klaassen (2002), where the authors examined positive effect of EMU (i.e. euro currency) on individual countries 'trade. There has been researches conducted on effects of trade agreements, effects of various membership criteria or effects of EMU on trade. One such work was published by Anne O. Krueger (1999): Trade creation and trade diversion under NAFTA, where author attempts to examine effects of Mexican, USA and Canadian entry in NAFTA. Numerous papers on effects of Brexit have been conducted, for example as is mentioned in the literature part coming from LSE authored by Dhingra, Swati, Ottaviano, Gianmarco I. P., Sampson, Thomas and Reenen, John Van (2016) The consequences of Brexit for UK trade and living standards. The added value of this paper is to hopefully create an argument for or/and against joining or leaving the European Union under various conditions for national policymakers.

Outline

1. Introduction
2. Gravity model: Theoretical Framework
3. Theoretical Overview: EU Integration, Trade Creation and Trade Diversion
4. Evaluation: Analysis of EU Integration Components
5. Model: Data & Methodology
6. Empirical Results
7. Conclusion

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Author

Supervisor

Chapter 1

Introduction

Originally, European regional cooperation formally began with European Coal and Steel Community (ECSC) established by Treaty of Paris in 1951 signed by six European states – Belgium, France, Italy, Luxembourg, West Germany and Netherlands. Purpose of ECSC was to prevent regional war conflicts over natural resources in Europe by means of common market for coal and steel, that was established between its members to allow for freer trade and eliminate the unnecessary competition over the resources. European regional cooperation progressed further with establishment of European Community (EC) (originally European Economic Community) by Treaty of Rome in 1957 signed by the same six nations. Later on, EC was enlarged by other seven European nations. EC was designed to establish common internal market by means of trade barriers elimination and establishment of Customs Union (CU). This regional agreement was formally the first step and the blueprint towards deeper European regional integration later on, to what have become globally known as the European Union (EU), after Maastricht Treaty was enacted in November 1993. EU has institutionally absorbed EC, which was embedded into EU structure as one of the three "pillars", others being judicial and police cooperation and common foreign policy. Moreover, free movement of capital and labour was introduced, making up four fundamental freedoms together with free mobility of goods and services already established in EC. Furthermore, common currency was introduced among 19 of current 27 (due to recent Brexit) member states that make up together a European Monetary Union (EMU) with most of other members being obliged to join EMU in the future. Today EU is one of the economically strongest economic bodies in the world responsible for over the third of the total world exports mostly comprising of machinery, vehicles, chemicals,

pharmaceuticals and natural resources. Notably the process of economic and political integration is not fully accomplished to date and the potential benefit of even deeper integration is yet to be achieved.

The main objective of this thesis is to inspect whether is EU responsible for trade growth of its member states through improved trade relations. The channels by which EU could stimulate membership nation's economic growth are multiple (e.g. regulatory, administrative, geopolitical or foreign investment channel). However, this thesis concentrates mainly on the trade flows perspective – how does EU (if at all) stimulate trade flows between its member states. Trade is arguably one of the most important factors of economic growth, especially in a globalized world of today, since every country must satisfy its national requirements for goods, services and resources to establish environment where economy and its citizens can thrive. Trading with other nations makes it much easier for countries to meet these needs. Literature review sections provide with wide scientific research on given topics and concludes on the effects. The most widely used and effective tool on policy analysis – gravity model is utilized with accordance to modern standards and most up-to-date methodological procedures to infer on the theoretical conclusions.

The thesis is structured into eight chapters. First chapter being introduction, second chapter introduces gravity model – the historical background, technicalities and existing research on the model justifying its use. Chapter three introduces important theoretical concepts on components of EU integration, trade barriers and trade theory. Fourth chapter builds on mainstream theoretical models which provide arguments in favour of beneficial effects of trade unions and simultaneously contains literature review on trade agreements and their economic effects. Not lastly, this chapter also contains discussion on other relevant issues of EU integration, that are however, less empirically testable. Fifth chapter documents data gathering, and specific methodology applied in the empirical analysis. Also, it documents the most frequent mistakes committed in policy analysis empirical literature and introduces possible solutions. Sixth chapter contains discussion on empirical results and seventh chapter concludes the thesis.

Chapter 2

The Gravity Model

Rigorous analysis of changes in the trade flows due to changes in trade policies such as the membership in European Union requires appropriate use of convenient analytical tools. One of the most popular tools will be briefly described and elaborated in this chapter and used in future chapters – the gravity model. Analysis will be based mainly on NBER paper by Baldwin Richard and Daria Taglioni (2006) and a Practical Guide to trade policy analysis which was created by WTO in cooperation with UNCTAD (Bacchetta et al., 2012).

2.1 History & Overview

The gravity model is analogy for Newton's law of universal gravitation, where Newton states that the gravitational pull between any two massive objects depends positively on the masses of the objects and negatively on the square of the distance between the cores of these objects. This law is formulated in the following equation:

$$F_{ij} = G\frac{M_i M_j}{R^2}$$

where M_i and M_j are the masses of these objects, G is gravitational constant, and R represents the distance between the objects. Analogically does the economic gravity model positively relate the relative economic sizes of two countries and negatively the trade costs (where distance is one of the key factors) to the bilateral trade flows. This practice the "gravity equation" first became known since the seminal work of Dutch Nobel Prize winner Jan Tinbergen (1962). In his work, Tinbergen related the attractiveness of trade positively to the economic sizes of any two countries and negatively to the trade costs between them. The economic size of a country is measured by GDP or output[1]

and trade costs include wide range of costs related to the trade between the countries such as: transportation costs, barriers to trade (i.e. political costs), lingual costs (i.e. cultural costs) and other costs. At that time the gravity equation was considered a mere empirical relationship between the economic sizes of countries and their distance with other costs to their trade (Economicsonline.co.uk, 2019). Critics objected gravity model being purely econometric tool without theoretical reasoning behind its mechanisms (Bacchetta et al., 2012). No theoretical explanation for such relationship was available at that time. Neither of the famous pre-gravity models; Ricardian model nor Heckscher - Ohlin model considered the size of economies to be of any significance, other than rather extreme case when country is very small thus having small production capacity. Nonetheless, extra-ordinary stability and explanatory power of the gravity equation prompted economists to search for theoretical foundations on which the gravity model could be based. Later, research has shown that gravity models could arise out of wide range of trade theories. For instance, Bergstrand (1985) demonstrated that gravity model can be based on monopolistic competition trade theory, developed by Paul Krugman (1979). In another instance, Deardorff (1998) elaborated that gravity model can also arise from classical factor-proportion explanation of trade. Eaton and Kortum (2002) managed to base the gravity-type equation on Ricardian model. In this context the renowned economist Alan V.Deardorff (1998) stated: „I suspect that just about any plausible model of trade would yield something very like the gravity equation".

[1]There are two interpretations of the "size" – depending on which side of the relationship is analysis based (exporter – total supply, importer – total demand). This means that some authors also tried to use different measures of output, not just GDP

2.2 Technical Discussion

General multiplicative form of gravity equation is following:

$$X_{ij} = GS_iM_j\phi_{ij}$$

There X_{ij} represents monetary value of trade flow or exports from country i to country j. M_j stands for all importer specific factors that affect importing country's demand for goods. S_i on the other hand stands for all exporter-specific factors that affect exporter's willingness to ship the goods. G is an exogenous variable that does not depend on trading countries which, for example could represent the level of world liberalization or other structural state of affairs. Lastly ϕ_{ij} is variable that is inverse of all costs linked with the bilateral trade. Flexibility of this equation is hidden in the ϕ_{ij} term where numerous relevant variables measuring trade costs other than bilateral distance are included. Such costs are of geographical character (dummies for landlocked areas or islands), cultural character (dummies for language or religion) or political character (dummies for trade agreements – tariff barriers, common currency or colonial ties).

In this respect the important contribution was made by Anderson and van Wincoop (2001). These authors demonstrated in their study, that the effects of omitted variable bias may be caused by not properly accounting for; both the bilateral and multilateral trade resistance. Theory, first developed by Anderson (1979) suggests that bilateral trade between a pair of countries is also dependent on the magnitude of costs of trade between both regions taken separately with their respective trade partners. Not surprisingly, nation with more resistant (i.e. more costly) bilateral trades will be more inclined to forge a new trade deal than the country that enjoys relatively free (less resistant) trade flows. For another instance, if two neighbouring countries were surrounded by the vast seas, their mutual trade could be much different than if the same countries were surrounded by other and especially bigger countries. Anderson and van Wincoop (2001) have demonstrated that gravity model estimation which fails to consider multilateral trade resistance variables is less corresponding to theory behind the estimation and thus, may lead to significant bias in the resulting inference. All of above mentioned underlies the importance of controlling for multilateral resistance terms (MRTs).

Furthermore, Anderson and van Wincoop (2001) derived micro-founded form of well specified gravity equation in the world with N countries and goods differentiated by countries as follows:

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

Where Y stands for world GDP, Y_i and Y_j are GDPs of trading countries, t_{ij} is the j's cost of importing a good from i and Π_i with P_j represent exporter and importer ease of market access (i.e. MRTs). These terms are low if for example the country i and j are far away from markets or if barriers to trade and other trade costs are present. Lastly, σ stands for elasticity of substitution between all goods and it is assumed to be greater than one to account for the fact that goods can be replaced by other similar goods.

Both general and Wincoop Anderson's gravity equations can be rewritten in natural logarithms form, due to the multiplicative nature of the equation. However, incorporating MRTs creates an obstacle to simple OLS analysis – specifically, model suffers from non-linearity of the structural model in explaining the trade flows (Anderson and van Wincoop, 2001). Authors chose to solve this problem by employing the system of non-linear least squares (NLLS). This approach, however consistent and efficient in producing estimates is computationally too demanding compared to simple OLS. Alternative to Anderson and van Wincoop's approach is "bonus vetus" OLS (BV-OLS) developed by Baier and Bergstrand, which however at a cost of small efficiency loss, compared to Anderson and van Wincoop's NLLS the method is much less computationally demanding and allows for use of OLS (Baier and Bergstrand, 2009). The key innovation authors brought is use of first-order log-linear Taylor series expansion that allows for OLS equation derivation including the exogenous variables that capture the effects of MRTs. Another issue that could arise from this form is the fact that multilateral resistance terms are not directly observable. It is thus convenient to proxy these variables.

Conducting an ex-post analysis using gravity model will serve well when looking for the empirical evidence of trade diversion and trade creation effects, that results from trade agreements. In this kind of analysis, researcher should be aware of two main issues, first of endogeneity of trade agreements and secondly of the cases where trade agreements are made in pursuit of goals other than trade increase, where there is a little reason to analyse trade creation and

trade diversion effects. In policy analysis literature, endogeneity is very prevalent econometric issue. For example, Jeffrey Bergstrand (2008) stated that the recent traditional empirical researches on effects of economic integration on trade flows considerably underestimated the benefits of free trade agreements (FTAs). Author assigns this to the endogeneity bias that was not taken into account by the researches[2]. The endogeneity problem is that regional trade agreements (RTAs) are usually unlikely to be exogenous, countries will more likely form RTAs with partners with whom they have been trading before. This means that dummy representing RTA in the gravity equation will be correlated with the error term, since unobserved characteristics of country pair is behind the increased trade between those countries and thus, there is greater probability of this country pair forming an RTA. In other words, the issue is reverse causality - the causal link between RTA and trade flow may be reversed. Consequently, the gravity model might be biased to a large extent. In this context Baier et al. (2008) have shown that after accounting for endogeneity of country-pairs forming economically integrated agreements (EIAs) the vast amount of EIAs had a tendency to increase member's trade by 100 percent over a period of 15 years. According to authors these results are consistent with the anecdotal claims of policy makers that suggested that the effects of EIAs are much bigger than what previous conventional ex-ante analyses have been suggesting.

In this respect, an important contribution was also made in a paper by Baldwin and Taglioni (2006), where authors have among other things, put together the so called "medals" of the most common errors committed by authors in trade policy literature. In short – golden medal mistake is committed when MRTs are not accounted for in the gravity equations, silver medal error is taking logarithm of averages instead of taking average of logarithms and bronze medal is concerned with improper use of aggregate price indexes. Nevertheless, this issue is tackled in more detail later on in the fifth chapter, including possible solutions.

Other frequent challenges include zero trade flows (OLS is specified in logarithmic form, where logarithm of zero is not defined), heteroskedacity (most data sets have heteroskedastic property which may lead to serious biases in

[2]https://voxeu.org/article/european-economic-integration-and-trade-how-big-was-boost

the OLS estimation methods) or proper specification of bilateral trade costs. More detailed description of challenges as well as proposed solutions and list of practical recommendations for estimating gravity model can be found in both Practical Guide by WTO (Bacchetta et al., 2012) and in UNCTAD - Advanced Guide to Trade Policy Analysis (Yotov et al., 2016). The exact methods of dealing with these issues will be discussed in more detail in methodology chapter.

2.3 Existing research on the use of gravity models in the analysis of effects of PTAs/FTAs

For the last 50 years gravity model was used extensively for international trade flows analysis for its exceptional explanatory power in spite of absence of theoretical explanation in the past. Tinbergen (1962) was the first to use gravity model to investigate the effects of FTA on trade by finding the positive and statistically significant effect on members of British Commonwealth. Later on, several studies emerged focusing on estimating the effects of major RTAs like EEC or EFTA and LAFTA. Due to rapid expansion of FTAs in the world since 1990s the number of papers trying to estimate its impact using gravity model picked up the pace. Although the gravity model's consistency with the reality is considerable the absence of solid theoretical foundations might cast doubt upon the predictions based on this model as was noted by Bergstrand (1985). However, as it was mentioned before, contrary to the popular conviction - there are numerous theoretical foundations applicable to the model; such as Krugman's monopolistic competition trade theory (Bergstrand, 1985), classical factor-proportion explanation (Deardorff, 1998) or Ricardian model as described by Eaton and Kortum (2002). Moreover, the implications of these micro foundations are indeed reflected in these empirical studies. Revisit (Evenett and Keller, 2002) for additional research on theoretical foundations of the model based on the two main theories of international trade: Heckscher-Ohlin theory and Increasing Returns theory. Considerable amount of publications concerning the methodology and various refinements of the model has come to existence since the gravity model was established (see for instance Anderson and van Wincoop (2001)). Gravity model is a preferred tool when it comes to evaluation of economic implications of policies or nowadays, particularly for assessing RTA effects on trade flows between nations (Baier and Bergstrand,

2007). Special focus was dedicated in the last four decades to research of trade flows-models that would determine the impact of certain events and make forecasts based on both past and present nation's performance. That gravity model is indeed very frequently used in RTA analyses is nicely summarized in tables in comprehensive papers authored by Kepaptsoglou, Karlaftis and Tsamboulas (2010) and by Bubáková (2013). Specifically, Table 1 in the paper on empirical review (Kepaptsoglou, Karlaftis and Tsamboulas, 2010) neatly summarizes 55 recent studies focused on trade flows and related policies. Authors have stated in separate columns the objectives, explanatory variables that were used and estimation techniques of each individual research that was considered. Similar table, additionally including results of various empirical researches was created by Bubáková (2013). It should be clear by now, that gravity model is major and one of the most widely used tools for trade flows analysis concerning the effects of trade agreements and related policies backed by number of renown economists.

Chapter 3

Theoretical Overview: EU Integration, Trade Creation & Trade Diversion

In this chapter the theoretical foundations are laid in order to proceed further later on, with the more-in-depth analysis of each of the major integration components that might influence the international trade. First section provides theoretical outline of significant components of EU integration that might influence international trade flows of membership nations. In next section the discussion on CU and FTA is provided as these are important integration components. In other sections a traditional Vinerian trade creation and trade diversion effects are outlined, and tariff theory is elaborated as it is the most prevalent trade barrier policy today. The next chapter builds on these theoretical foundations, investigating deeper to implicate the true effects of each of the components on nation's trade flows based on analysis of numerous research papers and respective literature.

3.1 EU Economic Integration and its Main Components

In theory there are different main stages of EU economic integration ranging from the weakest form (FTA) to the strongest form of integration (political union). Each stage is the cumulation of all previous stages as well. Lowest form of integration consists of establishing an FTA, thus abolishing the tariffs and quotas on international flows of goods by means of which increased intra-

EU trade is being promoted. A stronger form of integration is that of CU, which enacts common trade barriers policy against the non-members while enjoying free intra-union trade flows. In the next stage EU integration consists of establishing common market thereby guaranteeing free services, labour and capital mobility amongst the members also known as four fundamental freedoms. Single market in theory leads to more efficient redistribution of intra-union workforce and provides all investors with virtually costless capital movement which should lead to an increase in the growth of businesses and economies as whole. Next two stages of integration are economic and political integration that harmonize economic and political policies and centralize the key policies for the whole union. Nevertheless, in reality some nations chose not to pursue closer integration with the EU and thus, the theoretical concept of gradual stages of integration was not pursued. For instance, European Free Trade Association (EFTA) is regional trade organization that consists of four nations (Iceland, Liechtenstein, Norway and Switzerland) that enjoy an FTA with EU and also participate in European Single Market, however CU was not established at all. Another four states (Monaco, Andorra, San Marino and Turkey) have arranged bilateral CU with EU without actually joining the union and thus, not participating further in deeper integration. In fact, not even EU itself was developed in accordance to this theoretical integration framework. The first step towards EU was formation of European Coal and Steel Community (ECSC) which was established in 1951 by treaty of Paris, signed by West Germany, Belgium, Italy, France, Netherlands and Luxembourg. This agreement was originally proposed by Robert Schuman in 1950, as a way to prevent wars between Germany and France by means of common market for steel and coal which would eliminate the competition over natural resources. Therefore, no FTA or CU was formed prior to ECSC. Only later on in 1957 the European Economic Community (EEC) was created by the Treaty of Rome and it was purposed for establishing the first theoretical stages of integration – the CU.

Influence of harmonization and centralisation of policies on trade flows is out of the scope of this paper and is left as an encouragement for future research. This paper mainly focuses on the first two stages of integration and theory of single market.

3.2 Customs Union and Free Trade Area

Free trade area is a trade bloc[3] whose member countries have signed up to a free trade agreement.[4] FTA encompasses economic cooperation between two or more states where each of them agreed to reduce or fully eliminate trade barriers with co-members and thus, intensify trade with each other. Members of FTA enjoy free trade policy selection against the non-members and that is the key difference between CU and FTA. Instead the rules of origin are employed to eliminate trade deflection.

Customs union is a trade bloc, where all members of a block sign up to FTA and establish common external tariff against non-members of the CU.[5] CU is one step deeper form of integration than free trade area and it includes free trade area characteristics. Many of the most developed economies are engaged in some form of CU. For instance, most of European countries are members of EU as well as most of south America is engaged in southern common market and CU - MERCOSUR, Eurasian Economic Union (EAEU) which includes Russia and some of the Asian and European countries. There are few CUs formed even among African states (SACU, CEMAC, WAEMU, EAC) and some other CUs are yet to form (CER, AEC). Interesting studies focused on evaluating CU effect on trade and welfare is mentioned in the overview of FTA effects in chapter 4.

Indirectly, FTAs may have detrimental effects on overall efficiency of trade and therefore the overall welfare. Authors argued that bureaucratic burden (for instance rules of origin, confusion due to overwhelming number of FTAs, etc.) resulting from FTAs can slow down world's progress towards most efficient trade liberalized world (Bhagwati, Greenaway and Panagariya, 1998).More on evaluation of the effects of FTAs is to be found in fourth chapter.

[3]Intergovernmental agreement which reduces or completely eliminates barriers to trade
[4]GATT Article XXIV, paragraph 8, b)
[5]GATT Article XXIV, paragraph 8, a)

3.3 Static and Dynamic analysis

With the surge of PTAs in the First Regionalism period (late 1950s and early 1960s) during which several developing countries attempted to form CUs and FTAs the Vinerian and other static analyses of PTAs served as the prime theoretical framework. Since Viner's seminal work any movement towards free trade is no longer considered to be necessarily welfare-improving as economists used to assume before. For instance, Bhagwati and Panagariya (1996a, pp. 22-7) show that steady decrease in trade tariffs by one country against another will lead to welfare improvement until some threshold. However, after decreasing tariffs further below the threshold reaching 100 percent reduction FTA might even lead to net welfare loss. By now, three additional theoretical approaches towards PTA implications other than Viner's were devised. First the Kemp and Wan (1976) provide with seemingly restoration of pre-Viner arguments regarding sure welfare increase due to PTAs. However, authors only showed that the CU always could be crafted in a way that would be welfare improving for both members and non-members. Their theory differs from that of Viner's mainly in that the members of CU might set their external tariff, whereas Vinerian theory treated external tariff as exogenous (given) variable. Brecher and Bhagwati (1981) came up with the second approach in an attempt to estimate common market distributional effects on individual member nations. The third static approach the Cooper Massell Johnson Bhagwatti approach (Bhagwati, Greenaway and Panagariya, 1998) provided with framework answering whether CUs lead to minimization of the costs of import substitution, which in fact, as authors argued could.

Unlike First Regionalism period which was dominated by static analysis of immediate effects of PTAs, the Second Regionalism period was taken over by dynamic or time path analyses of PTAs. Dynamic analysis provides with answers on whether PTAs are in words of Bhagwati (1991) building blocks or stumbling blocks on a way towards free trade, worldwide. Specifically, the two analytical questions are in mind with the dynamic analysis of PTAs. First the question regarding incentives of PTA enlargement, where Baldwin (1993) contributes with his model explaining that the incentives to join PTAs will be positive. Author argues that the PTA will create "domino" effect with outsiders wanting to join PTAs due to worsened competitiveness of non-member nation's companies as compared to PTA member companies, that will result

in increased lobby for PTA membership. Moreover, the more nations decide to join the PTA, the greater economic pressure will befall on the non-member nations, thus the domino effect. And the second question is whether the PTA formation helps or harms the liberalized world trade. Krishna (1995) in his oligopolistic-competition model demonstrates that the PTA reduces incentives of member nations to liberalise with non-members. Also Levy (1994) in his political process model using effects of scale economies and product variety concludes that FTAs could potentially weaken the political support towards liberalized world trade. In this paper author mainly utilizes static form of analysis for empirical evaluation (i.e. trade creation trade diversion effects), nevertheless dynamic effects must be taken into consideration given the fact that European Integration was probably not purely motivated by static effects. Presence of such dynamic effects might affect the specifications of gravity models used for empirical analysis.

3.4 Trade Creation & Trade Diversion

The term trade diversion originated from Chicago School economist Jacob Viner's book The Customs Union Issue (1950). This term defines a situation in which trade between two countries is diverted from more efficient[6] country to less efficient country due to formation of customs union. The reason why trade becomes diverted from more efficient country outside CU to a less efficient country inside CU is that after abolishing trade barriers between members of newly formed CU the total costs of imported goods can be lower even though a new intra-CU exporter is less proficient than non-CU exporter. Thus, it is not surprising that trade diversion could lead to welfare losses. Nevertheless, special assumptions must be met for any trade diverting PTAs to be welfare reducing – there must be no substitution in consumption (i.e. indifference curves are rectangular) and production possibility curve (PPC) must be linear (i.e. constant opportunity cost along the PPC) (Markusen et al., 2005). Trade creation is a related term representing increase in trade flows between the members of CU after a trade bloc has been founded. The reason is decrease of trade costs due to abolishment of trade barriers and thus lower prices of final goods resulting in positive impact on demand for the respective goods. Finally,

[6]Efficiency here stands for the country's capability to produce exported goods

the net effect of the PTAs will largely depend upon the magnitude of trade creation versus trade diversion effects. The extend of the two effects is subject to many variables and is not simple to evaluate precisely. Such variables include the distance of the members towards each other, cultural and political state of affairs, reaction by non-members and many other factors. The Viner's framework of trade creation and trade diversion is even today among the most popular in evaluating overall welfare changes caused by trade policies such as CU and its overall effects, usually by means of carefully set up gravity models.

3.5 Theory of Second-Best

Theory of second-best suggests that an additional distortion (like the trade barriers) to an already distorted market could actually rise welfare or economic efficiency of the country, even though it is movement from more efficient to a less efficient state of the market (Lipsey and Lancaster, 1956). This theory, however, works pretty much the same in case of reversed movement. Movement in a direction of free trade i.e. from less efficient state to more efficient one could actually cause in aggregate the welfare reduction of a given country. This is the case when countries enter FTA and in effect trade creation is outweighed by trade diversion leading to welfare losses. However, this scenario, as mentioned in section 3.4. is only theoretically possible under fairly strict assumptions. Economists generally do agree however, that movement in direction of free trade (or to a more efficient state of market) leads to an increased welfare. This is seemingly contradicting the fact that FTAs could actually decrease welfare of the countries. In reality however, movement towards the more efficient state (potentially the formation of FTAs) may indirectly lead to creation of the inefficiencies elsewhere and the negative effects of these inefficiencies might more than offset the beneficial effects of the trade creation caused by FTAs in which case, the trade diversion outweigh trade creation (Suranovic, 1998, p.Chapter 110-2A). For instance, creation of FTA between country A, B and C will enable to lower their trade costs with each other. From A's point of view, however the trade with other partners might worsen due to the formation of FTA (for political or economic reasons), thus leading to higher trade costs than before, with non-member countries leading to welfare loss. Here second-best concept provides one of the theoretical reasons to why seemingly movement in the direction of more efficiency might cause welfare losses.

3.6 Trade Liberalization In Pre-Accession Period

In some cases the accession into EU was a long process and began as much as ten or more years prior to actual accession into the EU. For instance, some nations before officially entering EU had already in place some of the trade liberalizing agreements, thus reaping some of the benefits of EU even before being actually a member of the union. One example of such an agreement was Central European Free Trade Agreement (CEFTA), which was trade agreement among eastern European nations, that served as preparation for full fledged EU integration later on. Members of CEFTA established free trade area among them and to a large extend been trading with EU nations. CEFTA founding nations - Poland, Czechoslovakia (later Czech Republic and Slovakia, separately), Hungary have joined the EU in May, 2004. Another instance of pre-accession period liberalization agreement is Baltic Free Trade Agreement (BAFTA), which included Estonia, Lithuania and Latvia. BAFTA membership of each founding member was ceased as each member successfully entered the EU. See **Figure 3.1.** for other instances of pre-accession period liberalization. In addition to pre-accession agreements in some cases (Poland, Czech and Slovak federal republic, Hungary) existed also interim agreements on trade, that assured some of the trade benefits until the permanent Europe agreements are formally ratified. These interim agreements came into force in March, 1992. All of aforementioned agreements mimic the EU effect on trade liberalization to a certain degree. As a result, there is high possibility, that the EU effect will be underestimated by not accounting for these pre-accession period agreements as higher degree of trade liberalization was already achieved by these nations, prior to even joining the EU. Nevertheless, the purpose of this thesis is to measure purely the EU effect on international trade of membership nations. If simply liberalizing trade would negate all the benefits of EU membership, then there is little reason in creating such a union in the first place. Thus, it is author's belief, that the EU effect will still be positive and significant, although probably underestimated. Moreover, not every nation was participating in a pre-accession period liberalization agreements, actually most of them were not.

Figure 3.1: Liberalization Agreements In Pre-EU-Accession Period

Bulgaria EAA (1995)	acceded to the EU in 2007
Croatia SAA (2005)	acceded to the EU in 2013
Cyprus AA (1973)	acceded to the EU in 2004
Czech Republic EAA (1995)	acceded to the EU in 2004
Estonia EAA (1998)	acceded to the EU in 2004
Greece AA (1961)	acceded to the EU in 1981
Hungary EAA (1994)	acceded to the EU in 2004
Latvia EAA (1998)	acceded to the EU in 2004
Lithuania EAA (1998)	acceded to the EU in 2004
Malta AA (1971)	acceded to the EU in 2004
Poland EAA (1994)	acceded to the EU in 2004
Romania EAA (1995)	acceded to the EU in 2007
Slovakia EAA (1995)	acceded to the EU in 2004
Slovenia EAA (1999)	acceded to the EU in 2004
United Kingdom ACR (1955)	acceded to the EU in 1973

Source: www.consilium.europa.eu/en/documents – publications/treaties – agreements

3.7 Modern Trade Barriers

3.7.1 Tariffs

Tariff being the most common trade barrier policy is one of the trade policy instruments that national governments use to change the impacts of trade flows on domestic economy. It is essentially a tax on imported or exported goods which raises the costs of shipments of the good (Krugman, Obstfeld and Melitz, 2012). In the past also transit tariffs were utilised where nation would tax goods traveling throughout its land in order to transport goods elsewhere. Formerly, this instrument was used to raise revenues, later it became policy instrument able to protect domestic producers who were not able to compete with foreign exporters or to encourage domestic consumption. Tariffs may also represent a strategic tool to aid the domestic development of new sectors of interest and prevent foreign-takeover of native market share. Nowadays in developed world tariffs are used mainly for political purposes other than the increased revenues. Whether the tariff will have positive or negative impact on domestic economy of a given country depends mainly on market strength of that country as it is explained in the textbook by Krugman et.al (2012). In some cases, tariffs may have economically positive impact on an imposing country. If the country is strong enough to influence world prices by imposing trade barriers (i.e. it is importing majority of the world supply of a given good, thus by imposing tariffs the world price of a good will decline). Smaller countries however, are

unable to affect the world prices by imposition of trade barriers which according to theory means that the smaller economies will always lose economically by imposing tariff and other trade barriers (Krugman et.al, 2012), given that the existence of possible distortions is not considered. Another way tariff might be welfare improving is in case the market is already distorted to such an extent that additional extortion might actually have welfare improving effects – this effect is best explained by second-best theory discussed in previous section. Therefore, in conclusion majority of countries will most probably economically lose by imposing tariffs and other trade barriers on imports and only handful of economies will be able to reap benefits from tariff imposition given that no retaliatory measures are undertaken by other nations.

3.7.2 Non-Tariff Measures

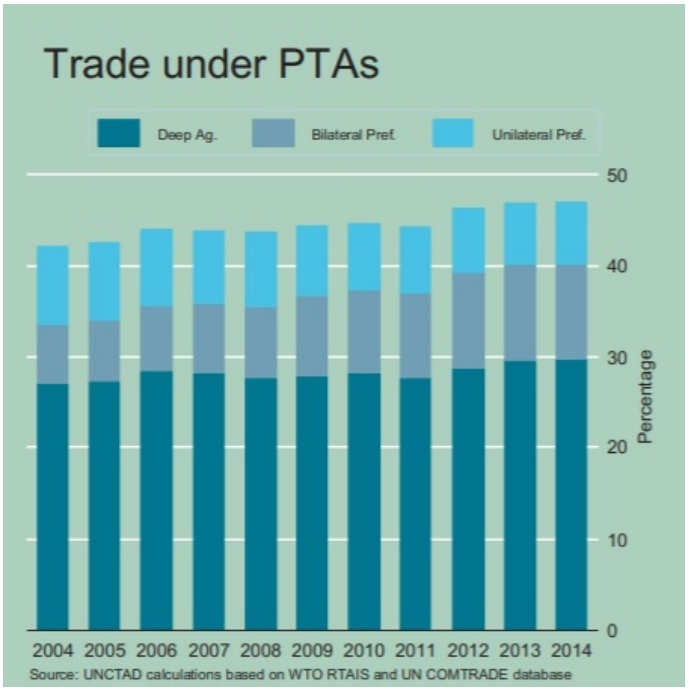
Non-tariff measures (NTMs) represent policies other than tariff measures, that could potentially affect international trade flows, which are increasingly shaping the trade by influencing the quantity traded and the prices. NTMs are primarily concerned with public, health and environmental protection. Some examples include food additives regulations, basic information labels of electric devices, anti-dumping duties or harmonisation of certain laws and regulations linked with exporting and importing of goods and services. In fact, in modern times NTMs overshadow tariff barriers to trade in both its importance and frequency of occurrence. Thus, it is not surprising that administrative costs linked to international trade might exceed the tariff costs. Mercantilism is no longer the best way of thinking about deeper forms of PTAs, since market access alone is insufficient when considering regulatory policies of modern PTAs (Maur, 2013).

Motives Behind PTAs

Politicians and policy makers are increasingly interested in establishing PTAs, which is evident by a single glance at the chart obtained from World Bank (see **Figure 3.2.**). The increasing trend of PTAs worldwide is evident with darker colours signifying the deeper forms of PTAs (depth of which is measured by number of provisions contained in the agreement). It is important to think about the motive behind this behaviour – are policy makers really so interested in PTAs, investing their time, political capital and other resources because of its economic benefit, effect of which is often ambiguous and difficult to estimate?

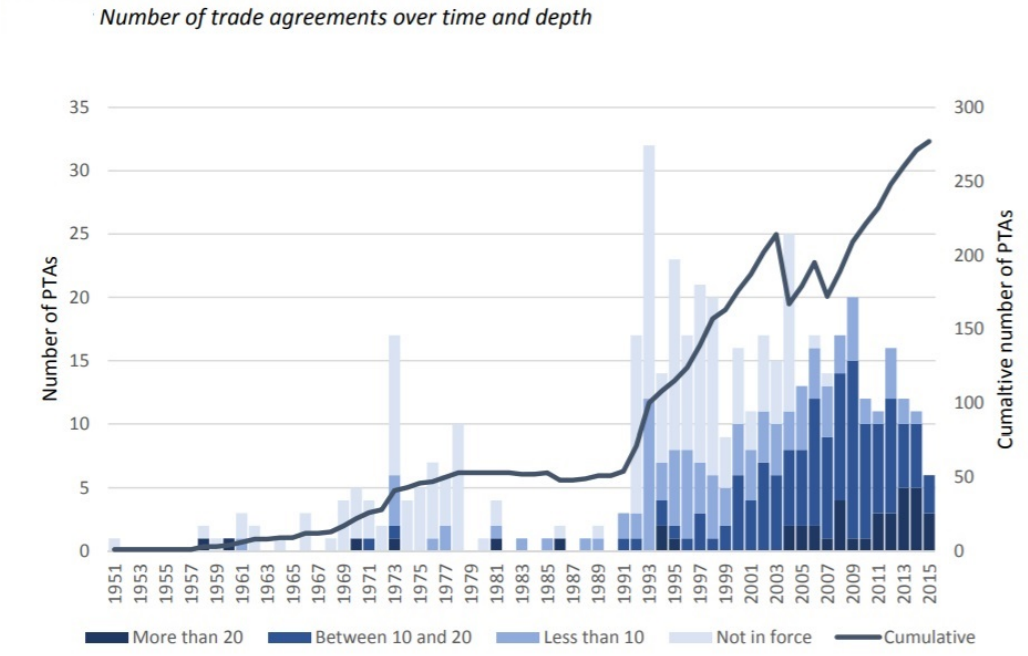
Or is there another motivation to form PTAs? Krugman (1993) theorised that one cause behind the success of PTAs is convenience of dealing with complexity and variety of modern trade barriers as compared to multilateral setting at WTO or GATT level. He implied that the abolition of traditional trade barriers was not always an answer towards an increased market access. Alternative theories were surveyed by Cooper, Schiff and Winters (2003) considering issue of importing beneficial regulatory practices, hegemonic nation's regulatory interests export, supranational coordination for regional policy goals achievement or foreign policy considerations. Some other alternative explanations behind deeper form of integration were also laid down by Maur (2013) – examples of which are regional externalities, information asymmetricity (especially in services trade it is important to establish common regulatory standards), supranational competition (international cooperation may be required to control monopolistic tendencies of international companies) or simply geo-strategic motives and some other theories are mentioned in the paper. Chauffour and Maur (2010) argue that preferences are indeed not so important as they were in the past, showing that tariffs are on a fall worldwide and protectionism is not so accentuated for most of the world anymore. By no means authors suggest that traditional tariff reduction is pointless, authors merely suggest that there are at least some PTAs where it makes sense to search for deeper motives other than traditional trade barrier reduction. Indeed, deeper form of integration that is beyond border-measures may be needed to stimulate the trade flows (Krishna, Mansfield and Mathis, 2012). This fact is reinforced by UNCTAD key statistics, which show that almost half of the world trade is being executed under PTAs, where about 30 percent of world trade took place under deep agreements (whose trade rules go beyond border measures) and another 15 percent of world trade was PTAs limited to border measures, see **Figure 3.1.** (Nicita, 2015).

Figure 3.2: World Trade



*Source: https : //unctad.org/en/PublicationsLibrary/ditctab*2015*d*2_*en.pdf*

Figure 3.3: Evolution of PTAs



*Source: http : //documents.worldbank.org/curated/en/*700771487791538589*/pdf/WPS*7981*.pdf*

Chapter 4

Analysis & Evaluation of EU Integration Components

As pointed out earlier, the formation of PTAs does not automatically lead to welfare improvement. Both static analysis of immediate effects and dynamic analysis of long-term effects of PTAs on trade flows are useful when evaluating welfare implications of PTAs (Bhagwati, Greenaway and Panagariya, 1998). The thesis considers static analysis, where Jacob Viner (1950) was the first to point out that PTAs can either decrease or increase the overall welfare of participating countries. This is where empirical analysis is useful, because theoretical reasoning alone cannot provide with strict yes or no answer to whether an overall effect of trade creation and trade diversion due to PTAs is welfare improving or reducing for both members and non-members of the treaty (Krueger A.O., 1999). Optimally policymakers would revisit both the theory and thorough empirical analysis to make an informative decision. Also, past empirics of a similar kind might come in handy. There is however a reason why not skip the theoretical revision – for example in extreme cases when formation of PTAs produces either great benefits or great losses the theoretical framework has a good chance of predicting that. In this chapter, literature review of major integration components is provided with theoretical reasoning attached to it. This chapter outlines reasons - why it is indeed plausible for many nations to co-integrate in EU.

4.1 Goods & Services Flow

In theory it is reasonable to expect that nation's integration will be less welfare improving in the short-run than in the long-run due to dynamic effects of integration (i.e. initial costs of adjustments and overall adaptation of economy to the new trade partners). Therefore, benefits of integration will come fully into fruition once the country fully integrates into the union, such as is EU, then numerous benefits are to be expected both for the country and already established members of the union. This section provides with theoretical framework on goods and services flows from both inter, and intra-industrial trade point of view. At the end of this section comprehensive literature review on effect of FTAs and CUs is provided. In next sections reader will go through the other major components of EU economic integration that might affect the trade flows.

4.1.1 Inter-Industrial Trade

First of all, most of the tariff and non-tariff barriers to trade will be completely eliminated upon EU integration. However, it is true that most of new EU members had already achieved a certain degree of trade liberalization with EU prior to joining the union (for instance association agreements). Due to this fact the EU might bring little to no benefit to some of the nations depending on the state of its trade relationships prior to accession in EU. Nevertheless, trade barriers elimination allows for cheaper goods flowing inside the EU and also for that the member nations can cover up for each other's "weak spots" in production and a greater degree of specialisation can take place. Benefits of "covering for each other" can be well represented by Heckscher-Ohlin's model of trade based on factor endowments. Each nation's endowments with labour, land and capital differs and to fully exploit differences in the endowments across nations is to allow each country to concentrate on production of goods that are abundant in the factor that the given country is most endowed with. This will lead to increased production and thus greater exporting capabilities of goods which might be scarce elsewhere, thus supporting trade, which among other things is guaranteed by EU Single Market. Specialisation on the other hand means, that each member country is given more space to concentrate on production of more comparatively advantageous goods by means of which the total efficiency of production of that specific good is increased through the effect of

economies of scale (Ricardo, 1969). Specialisation will eventually push prices of these goods down, which will lead to rise in consumer demand for the goods both directly and indirectly (this good may be a substitute to another goods – demand can increase through several channels). By this very mechanism the union members are lifted from less economically efficient state to the more efficient state, thus ending up increasing the overall welfare of its citizens. This is also called trade creation, where especially consumers and producers of exporting country are winners (the ones who reap most economic benefit) (Krugman, Obstfeld and Melitz, 2012). Coupled with it – the effect of trade diversion also provides union members with some of the benefits. Specifically, trade diversion might happen when a country enters EU, thus diverting its trade from non-member supplier towards less efficient, however member state of EU as result of trade barriers elimination, which in turn results in intensified trade flows inside the EU. This is natural since all members of EU must levy equal external tariffs against non-members which may disrupt old trading partnerships of the new members. However, strict assumptions of zero substitutability of consumption and constant opportunity costs of production must be met for trade diversion to have welfare reducing effects (Markusen et al., 2005). EU also encompasses the effort to create a single market which is equally important for trade costs reduction by the means of free movement of labour and capital.

All of above mentioned was concerning inter-industry trade mechanisms (trade between different industries). However, most of European and American trade consists of intra-industry trade (trade inside identical industries) Ruffin (1999).

4.1.2 Intra-Industrial Trade

The relevance of intra-industry trade was highlighted by numerous authors - two of them were Roy J. Ruffin (1999) and Paul R. Krugman (1979). Thus, it is vital to include theoretical framework explaining intra-industrial trade – Krugman's New Trade Theory (Krugman, 1979). Intra-industry trade is not motivated by comparative advantage, but instead by economies of scale and product differentiation. Underlying assumption of Krugman's model is that the industries have increasing returns to scale – by doubling the inputs of production, the output of production more than doubles. This effect in turn implies imperfect (monopolistic) competition which leads to increased incentives to-

wards international trade. Intra-industry international trade results in even greater industry size, further decreasing average production costs in the given industry and consequently increasing variety of goods and services from which consumers will benefit, mainly due to lower prices.

Well, what about effect of FTAs on trade flows? Most recent studies concentrate on evaluation of the regional trade agreements (RTAs) and coupled with it Viner's trade creation and trade diversion effects (Kepaptsoglou, Karlaftis and Tsamboulas, 2010). A number of studies on this topic were revisited to provide with comprehensive overview of already existing evidence.

4.1.3 Effects of Regional Trade Agreements on Trade Flows

Prominent economists Scott Baier and Jeffrey Bergstrand (2007) found that FTAs on average doubles the bilateral trade after 10 years. Moreover, as authors focused on more correct accounting for FTA variable's endogeneity showing, that effect of FTAs on trade flows quintupled as a result. Positive effects of RTAs were also backed by study by Magee (2008), where author have found that intra-block trade was shown to be stimulated comparatively more if members were engaged in CU than if they were only engaged in FTA. The superiority of CUs was proved to be even more significant in the long run. In fact, Magee (2008) estimated that both CUs and FTAs have on average same positive impact on trade flows in the first seven years of integration. However, by eighteenth year the effect of CUs was nearly double of that of FTAs. In comparison PTAs ended up stimulating trade the least of all the three policies. Author further concludes based on his results that RTAs will have different impact on countries depending on factors like distance, cultural closeness, geographic position and other variables. Grant and Lambert (2008) employed gravity equations to confirm their hypothesis that agricultural trade benefits disproportionately more from RTAs than non-agriculture sectors in the long run. Reason being more concentrated liberalization on agricultural sectors by WTO. Average effect of RTAs to increase member's agricultural trade was estimated to be 72 percent in contrast with non-agricultural sectors which was estimated to be 27 percent using their preferred specification (Grant and Lambert, 2008). Usefulness of RTAs was also supported by Kalirajan (2007) who concluded that Australia expanded its potential for exports due to regional cooperation (reducing trade restrictiveness) on average by 15 percent.

Abedini and Péridy (2008) found that GAFTA increased regional trade by 20 percent since its implementation using several estimators: transformed fixed effects, Hausman and Taylor and also GMM dynamic estimator on 1988-2005 period. In another study authors attempted to specify the effects of RTAs on trade flows by means of proper ex-post analysis of 130 countries identifying Vinerian trade creation and trade diversion effects, showing that RTAs have generated considerable increase in trade of RTA members, although often so at the expense of the rest of the world (Carrère, 2006). Another study held by Sarker and Jayasinghe (2007) also ended up with results implying reduced EU openness based on 1980 – 2000 data on six agri-food products. Authors argue that in the tested period intra-EU trade increased significantly however at the expense of non-members due to trade diversion effect, thus implying that EU became relatively less open to trade with rest of the world. More specific study by Endoh (1999), who analysed 3 major RTAs: EEC, LAFTA and CMEA concluded that the trade diversion and trade creation dummies proved to be statistically significant by means of appropriate choice of dummies for the period 1960 – 1994. Arghyrou (2000) constructed original trade flows data sets by means of which author also indicated the presence of gross trade creation and diversion effects concluding that Greek exports increased only moderately while losing comparative advantage in some of the sectors. Musila (2005) estimates intensity of trade creation and trade diversion effects of three FTAs: COMESA, ECCAS and ECOWAS in period 1991 – 1998. Author claims that the magnitude of both effects differs with respect to time and region reinforcing the idea that size factors (GDP, populace, etc.) and resistance factors (distance and language) play key role in determining these effects. Moreover, Musila (2005) presented empirical results suggesting that ECOWAS and COMESA were trade creating, however not diverting at all and that ECCAS is not trade creating, implying that formation of both former institutions led to welfare increase. Tang (2005) used gravity models to analyse trade effects of another three FTAs: NAFTA, ANZCER and ASEAN, demonstrating that ANZCER and ASEAN member countries facilitated increased trade among themselves further stating that ANZCER resulted in trade diversion with non-members and ASEAN on the other hand resulted in increased trade with non-members. Secondly Tang's results confirm the effect of income similarity for developing countries (i.e. the developing countries partaking in the same FTA will trade more intensely with each other given that their GDPs do not vary much). In 1995 Barcelona conference resulted in Euro-Mediterranean

(Euromed) agreement deepening inter-regional integration and thus progressing towards an FTA. Eventually gross trade creation resulted from the Euromed agreements exhibiting in increased exports of Mediterranean countries to EU by about 20 – 27 percent also implying that this result might promote alluring trade prospects between ASEAN and Northern countries (Péridy, 2005). For another instance recently, numerous studies were conducted on economic implications of Brexit suggesting on average that UK stands to lose approximately 3-9 percent of GDP due to Brexit in the long run (note that UK is not even a member of EMU), resulting percentage mainly depending on the underlying assumptions of the estimation methods (Ottaviano et al., 2014), (Tetlow, 2018). Given these results being correctly estimated, the benefits of EU membership clearly exists.

In conclusion numerous papers found Viner's trade creation and diversion effects to be significant and also the effects of FTAs are often statistically significant and trade increasing. There are some drawbacks to FTAs (increased administrative costs, political challenges), however economically, there seems to be little dispute on whether or not is FTA trade improving.

4.2 Monetary Union

Monetary union represents deeper form of economic integration, where members must participate in the third stage of integration to be permitted using euro currency. Currently 19 Eurozone members use euro currency out of in total 27 members of EU. This section dissects EMU membership and ceteris paribus effects of the union on trade.

Currency union may have significant positive effect on trade flows according to research paper on common currency unions (Rose, 2000) sharing common currency strongly encourages the trade between countries as it brings about stability and trust for the integrated countries. Another evidence strongly in favour of European currency union was provided in a research paper (Bun and Klaassen, 2002). Nevertheless, newer researches on this topic point at less optimistic, however still positive and statistically significant effect of MU on trade among members (Frankel, 2008), (Micco, Stein and Ordoñez, 2003), (Kurihara, 2003) or even none at all (Gabáš O., 2017). Indeed, there seems to

be no consensus among economists on whether the monetary union encourages the trade or has little to no effect on trade at all. Nonetheless a comprehensive meta-analysis by Havránek (2010) suggests significant Rose effect on Euro which is, however, even less optimistic: the estimate of 3.56 percent, which is further decreased after applying more strict meta-analytical methods. Rose (2000) continues that; especially for the smaller, economically weaker and more open nations it is advisable to enter the MU, because of disproportionate economic growth that is present in the MU – smaller countries have shown to have consistently higher economic growth rates than the bigger countries. However, another study (Frankel, 2008) proves there to be no relationship between size and the benefits of common currency, thus this argument is somehow debatable. Adversely, entering the EMU membership nations lose control over exchange rate and monetary policy since monetary policy is then centralized within the European Central Bank. This might worsen nation's ability to combat inflation and control the strength of currency under assumption of asymmetric shock. Currency control is one of the traditional policy tools that influences the international trade flows via depreciating or appreciating the currency.

In conclusion monetary union effect on international trade does not have definite answer and is subject to numerous variables, however newer researches and meta-analysis point at rather small positive effect if any at all.

4.3 Other Components

Other major EU integration components are free capital and labour movement. Unlike previous sections of this chapter, this section will mainly depend on theoretical reasoning for the lack of existing studies of capital/labour mobility effect on trade flows. Free labour movement enables workers inside the union to move freely across borders of membership states to find an employment of their preference. This makes redistribution of work force more efficient inside the union which benefits firms, workers and in the end the whole economy by means of increased productivity of companies. Firms are more able to hire workers that suit their requirements and emigrating workers are happy to work in a better paid company than what their domestic state companies offer. By this very mechanism companies become more able at exporting thanks to enhanced productivity and positive effect on trade is therefore evident. Although free

labour movement is generally beneficial it might hurt poorer countries that are part of the union for their workers may often chose to emigrate to economically stronger members to reap economic benefits therefore potentially rising unemployment and so called brain drain effect (smartest people chose to emigrate) may take place in the former country. Free capital mobility guarantees free flow of finances across borders so that investing activities are not discouraged by cross-border fees and other expenses. In theory enhanced capital mobility enables better capital distribution among the companies. Indeed, proper investment in the economy is one of the main engines of long-term economic growth. As suggested by OECD data EU membership had a positive effect on UK's FDI, for example due to better access to a single market (Tetlow, 2018). Moreover, EU combines numerous countries into essentially one complex with stronger bargaining power. This leads to economically more beneficial trade deals between the union and other countries as the power to influence terms of trade (and possibly own trade policies) is increased, and further increases with the number of members.

In theory each mentioned component of integration encourages higher trade flow between the integrated economies, thus making EU an attractive organization to participate in. Especially for smaller countries with low bargaining power, production and resources it very much makes sense to participate in a union. Moreover, it is safe to assume a positive relationship between the size of the EU and extent to which some of the described components contribute to the welfare growth. The more countries in total participate in EU the greater potential there is for welfare improvement within some component of economic integration. Final verdict is that the European Union definitely has significant benefits to offer to its members from trade flows point of view in the long-run, even though some of them are questionable at the moment.

4.4 Possible Drawbacks of EU Integration

As it is the case with everything - liberalised trade will produce not only winners, but also losers. In fact, dynamic industry – heterogeneous firms model invented by Melitz (2003) suggests that liberalized trade will have differing effect on heterogeneously sized companies. Model points out that strongest firms will accommodate to the liberalised trade and begin exporting abroad

thereby reaping most benefits of trade liberalization. Whereas average sized companies remain operating domestically, and small sized or least productive companies are predicted to exit the market due to market share reallocation towards more productive companies caused by trade liberalisation (Aw, Chung and Roberts, 2000). Thus, trade liberalisation might produce losers (mainly small and mid-sized companies) and lead to higher unemployment in import competing sectors. The losses could be mitigated if winners from liberalised trade, mostly exporters were to share portion of profits with the losers, which is however, almost never the case. Even if integration produces losers, economists reached a consensus that liberalised trade is in overall welfare-increasing policy and that the benefits outweigh the costs.

Once the country fully integrates into the union thereby sharing the same currency, participating in a single market and its production being highly specialised it will be rather difficult and costly to disintegrate in case voters wish to abandon the union. Such a country will face difficult task of restructuralization of its trade relationships entirely, which is of course costly and despecialization will take place. The leaving nation will transit from economically more efficient state to less efficient one and face reduced trade flows immediately. Reduced trade in the long run results in lower overall productivity and thus lead to decline in welfare - it is rather rare that a country would be able to grow over long time periods without cultivating and establishing trade relationships (Irwin, 2004).

For bigger, stronger nations it may be less beneficial to engage in unions than it is for smaller nations (Krugman et.al, 2012). There are two major reasons behind this – firstly, bigger nations tend to be more open to trade with other nations, thus joining the EU could potentially close them up in relationship with non-members. This is due to common external tariff which every member of EU is obliged to levy on non-member nations. Second reason being, that big economies that are able to influence the world prices are able to actually profit by levying tariffs on imports. While participating in the union of course, this privilege is no longer viable for individual nations but for union as a whole, thus partially at the expense of that stronger nation.

It is probable that if some nation decides to join the union its trade might be partially or entirely diverted from non-members towards member countries. However, this trade diversion is not motivated by efficiency of production but rather by trade barriers that the union levies on non-members. Thus, it might create inefficiencies, and potentially damage the non-members and members in the long run. Even though trade creation is favourable, the effect of the increased specialisation may hurt other less comparatively advantageous industries. Protectionist arguments – infant industry, national defence, outsourcing may be brought to the spotlight. Given that union is formed usually with friendly nations the defence argument can be neglected. Another point being that the largest economies do contribute most to the EU budget in order to partially redistribute wealth from stronger to weaker members which may seem unfair to the citizens of those nations. Nevertheless, the EU budget is usually not big – in fact in 2019 it amounted for only 148 billion euro which is comparatively smaller than the budgets of Austria or Belgium and at the same time most of EU tariff revenues end up in this budget

Chapter 5

Data & Methodology

5.1 Data

For the purpose of this thesis data from several widely used sources were pooled together to estimate EU effect. World Development Indicators database was used to obtain nominal GDPs[7] of various nations for period 1988 – 2018 as a standard measure of nation's economic size. Typical dummy variables used in gravity literature (common language, contiguity, colonial history etc.) and bilateral distances[8] were obtained from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) website. EU dummies for each country were created manually considering a nation being part of the union in a given year, only if the date of accession was the beginning of the given year or one of the preceding years. If nation joined EU in the middle of the year, say in May, the EU dummy would be equal to one only the year after the accession year. This conservative approach is to ensure that EU effect is not biased by pre - EU state of trade affairs. Finally, trade flow-export data were obtained via World Integrated Trade Solutions database (WITS) for period 1988 – 2018. Thus, final data set consists of unbalanced panel data set of 476 146 observations for period 1988 – 2018 built from 195 nations listed in appendix. Out of 195, 28 nations correspond to 27 members of EU and one ex-member.

There are, however, two issues that must be taken into consideration. Firstly, the span of data set must be as large as possible to account for long-term trends in bilateral trade flows. EU or not, the tendency towards liberal-

[7]GDPs in current dollar values

[8]more info on CEPII distance measures on: http://www.cepii.fr/distance/noticedist_en.pdf

ized trade would be still present among the European nations. This point is supported for instance by Berger and Nitsch (2008), where authors found evidence suggesting the EMU effect on trade was insignificant in the period 1948 - 2003 after controlling for trend in trade integration as opposed to several other studies at a time suggesting significant and positive EMU effect on trade. Nevertheless, EU integration is a combination of numerous trade enhancing policies other than common currency thus, these results in no way suggest total EU effect being insignificant. Secondly, the higher number of nations that are included in the estimation, the more precise results are to be expected due to greater control of multilateral effects.

5.2 Methodology

In this chapter a detailed construction or methodology of gravity model is provided with accordance to the modern, recommended approach mainly by Baldwin and Taglioni (2006) and Practical Guide (WTO) authored by Bachetta et al. (2012). As mentioned before, gravity models are efficient in estimating bilateral trade flows by relating sizes of economies and trade obstacles to the distance between them. Each method has an advantage and disadvantage, different research questions might call for different methods. In this paper recent recommended specifications from mainstream literature will be used.

Gravity model evolved a lot compared to the very first form. Especially the theoretical background flourished as the model became more and more popular and increasing number researchers focused on this model. The noteworthy contribution was made by Anderson and van Wincoop (2001) by introducing theoretical multilateral resistance terms which better specified price effect on bilateral trade flows. Omission of MRTs was later identified by Baldwin and Taglioni (2006) as the most serious mistake committed by researchers using gravity model - the authors named it the “gold medal mistake”. Before this important piece of theory was introduced many researchers even renown, were committing this gold medal mistake by not accounting for country’s relative trade barriers with all other countries besides the one the research was concerned with. Although Lucas critique existed even before medals, where Robert Lucas critiqued naivety of economic policy forecasts based on historical and especially highly aggregated data (Lucas, 1976). It is just natural, that

the bilateral trade of two countries is also affected by third party countries which can become even more attractive trading partners than the former one. The authors Anderson, van Wincoop (2001) have also elaborated a derivation which uses CES function by means of which the theoretical background became more simple due to the transformations they used. Disadvantage of their work is that their derivation is applicable only on cross-sectional data. Fortunately, later on Baldwin and Taglioni (2006) generalized the gravity model so it can be applicable on panel or time series data.

The generalization: They begin with classical economic identity of supply and demand. Afterwards adopting CES demand function under assumption of all goods being traded and that share variable depends only on the relative prices they show that share variable is proportion of price terms, where one of the prices can be expressed in terms of the other price and variety of goods including elasticity of substitution among all varieties. Here symmetrical variety of goods traded are assumed to avoid introducing a variety index. Authors were aware of price data unavailability thus, they have further modified the equation by means of bilateral trade costs (both man-made and natural) and bilateral mark-up, arguing that nation's price of goods imported from another nation are linked to the costs of production in exporting nation, bilateral mark-up and bilateral trade costs. Based on Dixit-Stiglitz's monopolistic competition mark-up can be assumed to be equal to one to simplify the already complex equation. Combining all of the above mentioned into single equation Baldwin and Taglioni (2006) obtain value of bilateral trade between two nations. However, authors went further by eliminating second price term and variety variable (again due to lack of data on these variables) by means of general equilibrium in exporting nation under assumption that all goods must be sold and thus wages would adjust to market conditions. Again, putting it all together and reformulating Baldwin and Taglioni (2006) presented a complete micro-founded gravity equation:

$$V_{ab} = \tau_{ab}^{1-\sigma} \frac{Y_a E_b}{\Omega_a p_b^{1-\sigma}}$$

Here V_a represents total value of bilateral trade, τ_{ab} stands for bilateral trade costs, Y_a is the value of GDP of nation a, E_b is expenditure variable of nation b and Ω_a stands for market potential, sometimes also openness to trade, which is usually measured as sum of real GDPs of all trading partners divided by bilateral distance. This term is also what is called multilateral trade resistance

as it is basically a sum of bilateral trade flows with all the nations including trading costs. This form however cannot be estimated using OLS – it must be first transformed in log-log form.

5.2.1 Most Common Mistakes

Endogeneity

Endogeneity is an important component that might explain why otherwise well-constructed gravity models may report false results. First of all, having explanatory variables that are correlated with the disturbances results in omitted variable bias and inconsistency of estimates, which is the most common cause of endogeneity (Baier and Bergstrand, 2007). This is one of the reasons why panel data come in handy for there are certain tools that help us eliminate the unobserved effects that correlate with the explanatory variables of our interest. Specifically, first differencing, fixed effects or random effects methods of estimation are well suited for this issue and very often used by researchers (Bubáková, 2013), (Baier and Bergstrand, 2007). Among other (rather inferior) methods are use of instrumental variables (Wang, Wei and Liu, 2010) or addition of multiple variables into the model to lower endogeneity.

Another two sources of endogeneity are measurement errors in data and simultaneity issue where causal link is not one way, but both ways. Simultaneity issue arises when there is no clear causal link or when two events are mutually causally interconnected. For example, when analysing trade agreements two situations might happen: 1) nations form an FTA leading to more abundant trade flows and 2) nations whose relationship was improving as well as trade flows decide to form an FTA mainly due to political reasons. In the second scenario gravity model would report trade growth that is as if caused by formation of FTA and additionally the growth that was caused by good recent relationships between the authorities of the two nations which may not be the result of an FTA at all in reality. Here the gravity model would therefore, attribute too much credit to a newly formed FTA, whereas in reality FTA might represent just a gesture of integration rather than actual integration process, that had already happened between the nations. Motivation and circumstances behind the integration are an important indicator of why the nations are forming the trade agreements (Bachetta et al. 2012). Widely preferred way to correct

simultaneity is use of instrumental variables (IV) or two stage least squares (2SLS) estimator, where the theoretical reasoning behind the use of specific IV is rather difficult to test and it is mostly up to the researcher to make an appropriate analysis of existing linkages. For example, historic colonial link between the nations, cultural similarity, lingual similarity and other historical contexts all these factors may help in the analysis.

Time Variant & Time Invariant Biases

Sometimes researcher observes country or country-pair specific time invariant effects, where some of them can be easily approximated, whereas others may be rather difficult to quantify. Theoretically, there is no consensus on the ideal specification of gravity models to tackle this issue. One of the viable solutions is to include country-pair, or nation dummies to the standard OLS estimation, where the pair dummies are to be preferred in panel data. Pair dummy would be equal to one whenever the observation is concerned with the specific country-pair (Baldwin and Taglioni, 2006). However, this approach is equivalent with fixed effects estimation that effectively eliminates time invariant variable issue from the definition. Additionally, not considering the pre-EU tendencies towards economic integration will lead to biased estimates, for the model might assume the effect of integration to be greater than it truly was. Again, there are few methods of dealing with the time variant bias, most interesting of them the linear time trend (Berger and Nitsch, 2008) and second option is inclusion of time specific dummies which as Bachetta et al. (2012) argue is more accurate than the first method. Moreover, when making use of panel data - it is useful to account for the fact that MRTs might also change over time (Bachetta et al. 2012). Widely used, one of the easiest approaches to control for time-varying nature of MRT is to utilise importer and exporter time varying effects, where for a sample of T periods there would be T of those dummies. However in case variable of interest is time varying, then this approach will be useless, since the estimation of such variable will become impossible due to time varying nature of the variable (Baldwin and Taglioni, 2006).

Cross-Sectional or Panel Data?

There is no great disagreement or confusion unlike other parts, when it comes to the choice of which data set is better suited for econometric estimation of international trade. In the past cross-sectional data was used more frequently

mainly due to easier data availability, however modern researches pointed out numerous benefits of panel data estimation compared to cross-sectional data. Specifically, Carrère (2006) have proven that panel data produce more reliable average RTA effects on trade under correct specification of the model than cross-sectional data do. In another instance Baier and Bergstrand (2007) concluded that FTA effect on trade flows based on cross-sectional data were underestimated by approximately 75 – 85 percent most probably because of unobserved heterogeneity. Furthermore, authors argued that method of instrumental variables does not control heterogeneity well in case of cross-sectional data and in the end, they recommended use of fixed effects method on panel data instead. Panel data structure is also preferred by Bachetta et al. (2012) for its time series structure where fixed effects and random effects estimation methods can be utilized, for these methods are powerful tool, when it comes to time fixed omitted variables which must be taken care of. The importance of heterogeneity is emphasized for example by Stack (2009) by showing that with increasing heterogeneity in the model the EU membership variable becomes less significant until it became entirely insignificant. These results clearly emphasize the importance of correctly handling the heterogeneity in the estimation using panel data structure.

Zero Trade Flows

There are numerous different gravity specification methods used in estimation, one that was frequently used was log-linear form of gravity equation. Many were worried however, about zero trade flows which are not exceptional in international trade flows data sets, that led to undefined logarithm. Missing data is not that much of an issue as it could be simply dropped, and the estimation could still be based on smaller data set. However, dropping off zero trade flows becomes problematic when these omitted observations appear in patterns which may lead to inconsistent estimates and thus should not be dropped under these conditions. Moreover, the zero trade flow might represent genuine lack of international trade flow, which is undeniably valuable observation and should not be dropped. Today there are several ways of overcoming this issue. Each of the method is applicable in different situations and has its own drawbacks, thus there is no universal approach.

Bachetta et al. (2012) elaborated on two of the following methods: First of all – simplest approach is dropping zero trade observations. As it was mentioned researcher should proceed carefully as dropping zero observations is not standard and justifiable econometric approach which will lead to inconsistent results in case zero observations exist in patterns. Thus, dropping zero observations is considered as a last-resort procedure and should be applied only under randomly distributed zero observations assumption. Second simple approach is substituting zero observations with small constant say: 1-dollar value, in case dropping the observations is undesirable, applicable only under same assumption as first approach. Another issue with this method is the preservation of erroneous (missing) observations in the data sample rather than omitting those.

Other approaches concentrate on estimation methodology rather than data modification, for example using OLS on levels or Heckman's estimator that utilises two-stage estimation method also introduced by Helpman et al. (2008), which works the best when there is good knowledge of excluded variables. However, OLS used on levels is problematic for theoretical reasons as there is no theoretical justification on multiplicative form of model (Bachetta et al. 2012). Heckman's method on the other hand might be demanding and insufficient when it comes to heteroskedasticity issue (Heckman's model constitutes log-linear OLS specification, that is subject to heteroskedasticity due to Jensen's inequality), thus producing potentially biased estimates. From this perspective Poisson pseudo maximum likelihood (PPML) estimation seems to perform comparably better than other methods (Silva and Tenreyro, 2006) and its popularity compounds in the recent literature. PPML estimates gravity equation in its original multiplicative form avoiding problematic log-linear specification at the same time being applicable without need for random distribution of zero observations assumption (Silva and Tenreyro, 2006). The PPML method will be described in more detail later on.

Medals - Most Frequent Errors

Another important issue to discuss are so called medals or the most common mistakes that researchers commit will be mentioned next. These are called gold, silver and bronze medals.

Gold medal mistake concerns the multilateral resistance terms Π_i and Pj as suggested by Anderson and van Wincoop (2001). The obvious issue with these is that they are theoretical constructs and thus hardly observable. Instead multilateral terms need to be either proxied in the gravity equation or dealt with in some other ways. Some of the best-known methods are: non-linear estimation (Anderson and van Wincoop, 2001), use of region-specific fixed effects (Anderson, van Wincoop and Feenstra, 2004) or by use of Taylor expansion as in BV-OLS (Baier and Bergstrand, 2009). By omitting these terms or by mistakenly approximating them using "remoteness indexes" that are constructed as a function of GDPs and bilateral distance researchers are committing gold medal mistake. Baldwin and Taglioni (2006) propose the use of time invariant pair dummies to eliminate this problem.

Silver medal mistake is probably most common mistake and it is called reciprocal averaging error. Researchers often fail to realise that log of average of trade flows is not the same as average of logs of trade flows, this is given by the directional property of the flows used in the gravity model. Theory suggests that correct way of averaging is taking the average of logs, not the log of average value of trade flows. Using log of average of trade flows will produce serious bias to the results except for the countries with bilaterally balanced trade (Baldwin and Taglioni, 2006).

Bronze medal mistake is somewhat a minor mistake and it is linked to unsuitable deflation of nominal trade values leading to biases via non-existing correlations. This happens typically by use of aggregate price indexes. Improper deflation of bilateral trade could potentially reverse the policy conclusions of the gravity model estimates. Easy fix to bronze medal mistake is including the time dummies that offset this error (Baldwin and Taglioni, 2006). However usually by taking care of gold medal mistake the bronze medal is automatically taken care of, when time dummies are employed (Bacchetta et al., 2012).

5.3 Methods of Estimation

Some of the most renown estimation methods can be divided into two subgroups with respect to the procedure of the dealing with zero value of dependent variable. The first subgroup of estimation methods consisting of: Ordinary Least

Squares (OLS), Bonus vetus OLS with GDP weights (BVW) and simple averages (BVU), Structural Iterated Least Squares (SILS), Tetrads, Fixed Effects and Double demeaning (DDM) are defined in log-log form, thus these methods are intolerant towards zero explained variables, as logarithm of zero is not definable. The second subgroup consisting of: Poisson Pseudo Maximum Likelihood (PPML), Gamma Pseudo Maximum Likelihood (GPML), Negative Binomial Pseudo Maximum Likelihood (NBPML), Non-Linear Least Squares (NLLS) are established in multiplicative form of linearly derived gravity estimation models (Head and Mayer, 2014). Therefore, zero dependent variable is not an issue in the second subgroup of estimation methods.

In effort to compensate for the weaknesses of respective estimation methods the OLS from first subgroup and PPML from the second subgroup were chosen as the main methods of estimation for this thesis. This guarantees that the OLS methods used to deal with zero trade flows issue are not seriously flawing the estimation results by comparing those with the results produced by model tolerant towards zero values such as is PPML and vice versa. Of the OLS specification methods, Fixed Effects was chosen and also Random Effects. Among other methods the Tobits were bypassed because of criticism in gravity literature (Bachetta et al. 2012). NLLS generate precise estimates, however for purposes of this thesis the method is mathematically too demanding and concerning Tetrads there were performance issues with the method (Head and Mayer, 2014). Among others, literature on zero observation issue recommends using zero inflated negative binomial estimation method ZI-NB, which can even outperform the PPML in the case of excessive appearance of zero observations in the dataset (Burger, van Oort and Linders, 2009). However, theoretical background for panel estimation based on ZI-NB is non-existing.

The problem with OLS is that the observations with null dependent variable will have to be dropped as it is the simplest solution. In case that these observations are not randomly distributed however, it might lead to a biased resulting estimate. Alternatively, substituting the zero values with a single dollar value would produce logarithms of the zero variables to be equal to zero, however this leads to the similar complications. For instance, some portion of the missing trade flows then would be assumed to be zero, although in reality missing data is not the same as no trade at all. The magnitude of the

bias depends on the sample characteristics, nonetheless it is not advisable to assume that it is negligible. That's where PPML comes in as more elegant solution to this issue (Silva and Tenreyro, 2006).

Pooled Ordinary Least Squares

The earliest attempts of estimation of gravity equations were done using simple OLS regression (Jan Tinbergen, 1962). One of the main reasons why gravity model became so popular was that simple OLS is also applicable in the gravity estimation process (Baier and Bergstrand, 2010). This is the very basic method of gravity model estimation taking advantage of the multiplicative form of gravity equations, which can be rewritten into the log-linear form. This form of specification is desirable also because of the parameter values of log-terms being elasticity coefficients. Meaning 1 percent change in explanatory variable will cause ceteris paribus $1\%*\beta$ (corresponding parameter) change in explained variable, thus providing a straightforward interpretation of regression estimates. Moreover, log-linear form implies that the main variables including explained variable will be in logarithmic form however, the dummies and other variables will remain in the linear form. The downfall of this method is as was mentioned before the issue of zero value of dependent variable, which is not defined for a function of logarithm. More importantly, the pooled OLS does not account for MRTs, which may lead to significantly biased results.

Fixed & Random Effects

Fixed effects is standard, widely advocated panel data method of estimation. As for example Cardamone (2007) shows in his survey of 115 research papers on effect of PTAs, the most prevalent method used in the estimation was fixed effects, which moreover, was mostly preferred to random effects. Recent empirical literature estimates MRTs mainly by means of fixed effects specification. More specifically, best practices today use dynamic panel model estimation including exporter-time and importer-time fixed effects, simultaneously addressing the issue of endogeneity bias that arises from unobservable heterogeneity across the pairs as shown by Baier and Bergstrand (2007). As mentioned before, EU integration is a continuous process and the expected benefits will not necessarily appear immediately. In pursuit of proving this point, the new variables monitoring the lagged effects of EU integration were created. Specifically, two pairs of additional dummy variables: EU_lag$_{ot}$, EU_lag$_{dt}$ and EU_lag2$_{ot}$,

EU_lag2$_{dt}$, first pair representing lagged EU variable with the three years delay and the second pair being the same, however lagged by five years. Say, Finland joined EU in 1995, then EU_lag would be equal to one only starting from 1998 and EU_lag2 would be equal to one starting from year 2000. This way it may be roughly approximated in which time-periods the current member nations reaped most benefits from the integration. Whether the EU effect is stronger upon the accession, or indeed as argued, rather later on. Moreover, in order to measure the trade diversion and trade creation effects the dummy variables both_in and one_in with accordance to the practical guide (Bachetta et al. 2012) were added. The dummies are equal to one, if both of the nations (at least one of the nation in the second case) are members of the EU, and zero otherwise. Then inspecting the signs of the estimated parameters will be helpful in specifying the trade effects. Furthermore, the model specifications were divided into three equations to prevent EU dummy variables from clashing with each other and the trade creation dummies. Thus, the specifications of gravity models using fixed effects set-up are as follows:

Specification (1) estimating the sole EU effect

$$ln(X_{odt}) = \beta_0 + \beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \beta_4 EU_{ot} + \beta_5 EU_{dt} + a_{od} + \gamma_t + \epsilon_{odt}$$

Specification (2) estimating trade creation effect

$$ln(X_{odt}) = \beta_0 + \beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \beta_4 one\_in + \beta_5 both\_in + a_{od} + \gamma_t + \epsilon_{odt}$$

Specification (3) estimating the rest of EU dummies including EU effect

$$ln(X_{odt}) = \beta_0 + \beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \beta_4 EU_{ot} + \beta_5 EU_{dt} + \beta_6 EU\_lag_{ot} + \beta_7 EU\_lag_{dt} + \beta_8 EU\_lag2_{ot} + \beta_9 EU\_lag2_{dt} + a_{od} + \gamma_t + \epsilon_{odt}$$

There X_{odt} is an explained variable of bilateral trade flows that measures exports from o (origin) to d (destination) at specific time period t, as it is common practice. The main variables of interest are EU_{ot} which is dummy for exporter nation's membership in EU at time t and EU_{dt} which represents importer's membership in EU in period t[9]. a_{od} is variable denoting all country-pair

[9]EU dummy equals 1 if the respective nation is member of the union and 0 otherwise

specific effects that are unobservable and invariable in time that influence the bilateral trade. For instance, pair fixed effects required to cure (at least partially) for MRTs time invariant characteristics (Baldwin and Taglioni, 2006) are included in the a_{od} term. γ_t stands for time dummies designed to take care of time variant bias. ϵ_{odt} is the error term. If fixed effects estimation eliminates time invariant unobserved effects that are correlated with other explanatory variables, the random effect estimation does the same, however it is more efficient under condition that the unobserved effects are not correlated with independent variables. In that case random effect should be preferred and Hausman test will help in determining which method is more suitable. The fact that fixed effect is being mostly preferred by similar studies implies that there most probably is correlation between time-invariant pair characteristics and the independent variables used in the model. However, the test will provide a clear answer. To better control for MRTs or golden medal mistake it is proposed by Baldwin and Taglioni (2006) to control for time variant nature of MRTs by, for example including time-variant nation dummies. Inclusion of these dummy variables did not fare well with the specifications of this thesis, caused by the fact that most dummy variables of interest in this study are not dynamic enough. This leads to high correlation and results in omission of estimation results by model. Thus, to control for time-variant bias of MRTs different method should be used (for instance BVU-OLS or Tetrads etc.).

Poisson Pseudo-Maximum Likelihood

Poisson Pseudo-Maximum Likelihood (PPML) is the method from the second subgroup (i.e. multiplicative form equation) which means that it works well with zeros in dependent variable, since it may be applied on levels of trade. It might be wise to include zero trade flows as these might carry relevant information. Truncating such observations might lead to biases, since OLS treats these zero dependent variable observations as if they were measurement errors (NAs), whereas in fact zero trade flows might signify no trade at all - and such observations surely influences the results of the model. As demonstrated by Silva and Tenreyro (2006), there are also some other advantages to PPML estimator as compared to OLS. Specifically, PPML controls for heteroskedasticity by under-weighing outlying observations that are prevalent in trade data and performs well even when proportion of zero trade flows are exaggerated.

However, this is conditioned by assumption of conditional mean E[$y_{od}|x$] being proportional to the conditional variance V[$y_{od}|x$] of the model, which in reality happens rarely. Thus, reporting robust standard errors is advisable with PPML estimates. Just as before, the model will be divided into two equations, estimating them separately. PPML estimation equations are then defined as:

Specification (1) estimating the sole EU effect

$$X_{odt} = \exp[\beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \beta_4 EU_{ot} + \\ + \beta_5 EU_{dt} + \gamma_t + a_{od}] + \epsilon_{odt}$$

Specification (2) estimating trade creation effect

$$X_{odt} = \exp[\beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \\ + \beta_4 both_{in} + \beta_5 one_{in} + \gamma_t + a_{od}] + \epsilon_{odt}$$

Specification (3) estimating the rest of EU dummies including EU effect

$$X_{odt} = \exp[\beta_1 ln(GDP_{ot}) + \beta_2 ln(GDP_{dt}) + \beta_3 ln(dist_{od}) + \beta_4 EU_{ot} + \beta_5 EU_{dt} \\ + \beta_6 EU\_lag_{ot} + \beta_7 EU\_lag_{dt} + \beta_8 EU\_lag2_{ot} + \beta_9 EU\_lag2_{dt} + \gamma_t + a_{od}] + \\ \epsilon_{odt}$$

The PPML set-up is very similar to FE equation set-up, where the only change is that dependent variable that represents exports from nation of origin - o to the nation of destination - d is not logged. Fixed effects dummy structure remains the same as in FE specification.

Chapter 6

Empirical Results

6.1 FE x RE

As discussed before, most studies on a given topic are executed via fixed effects method rather than random effects. This implies that there mostly is correlation between time-invariant unobserved heterogeneity and the explanatory variables in the model of trade. Employing the Hausman test on both estimated models as specified in preceding chapter this proves to be true even in case of this thesis. The tests produced very significant p-value, meaning that for this trade model the fixed effects method is strongly preferable to random effects, since unobserved heterogeneity is strongly correlated with the independent variables, as expected.

6.2 EU Effect

Table 6.1. shows estimated coefficient results of FE specification method, using data set of 446 679 testable observations. Moreover, due to presence of heteroskedasticity, that was confirmed by Huasman test, robust standard errors, clustered with pairs were used to account for it. Second table (**Table 6.2.**) shows results of a PPML model specification, that was estimated using data set of 454 031 testable observations, including zero observations that were omitted in former specification method. Robust standard errors are also included. The interpretation of the results are same for both specification methods - FE being estimated as a log-linear regression and PPML uses the log of expected count (dependent) variable, needs to be interpreted using following equation:

$$elasticity = exp^{coefficient} - 1.$$

As expected, GDPs are significantly and positively influencing the trade flows of both importing and exporting nations as reported by both FE and PPML models. Distance coefficient was not estimated by neither of the models due to inclusion of pair fixed effects into the model to partially control for gold medal mistake, which results in perfect collinearity between the two terms. FE model produced positive and statistically significant EU_{ot} dummy coefficient of 0.302 in the first specification, similarly PPML also produced significant and positive result of EU dummy of 0.369, both estimates being at 1% significance level. Thus, both models imply positive and significant EU effect in the range of 0.30 - 0.37 increase in trade flows for exporting nations under the EU membership.

The positive EU effect was also found in case country is an importing one EU_{dt}, although in case nation is a trade destination the EU effect was smaller in magnitude and less significant, with results being approximately 0.201 as estimated by PPML and 0.143 as estimated by FE model, with 1% significance level in both models. Therefore, even for importing EU nation there was found evidence of increased trade flows, although less so than in case of exporting nation.

Inspecting these results, clearly the EU effect turns out to be statistically very significant and positive, both models estimating the coefficient of EU dummy to be more than 0.30 for exporting nations in the long-run and approximately 0.14 - 0.20 increase in imports in the long run. Moreover, these results imply that the EU effect is more intense in those cases, when nations were exporting ones, than importing. This could mean that European Union is more of a self-serving union that effectively boosts its inner trade flows and thus exports both inside and outside the union, however less so in case of the imports from outside the union. Or it could mean that exporters are greater beneficiaries of the EU membership than the importers. However, additional evidence would be necessary to support these hypotheses. Noteworthy, as discussed in section 3.6. the EU effect is expected to be underestimated as it is, because of omission of pre-accession period, EU-related trade liberalization of some of the nations. Therefore it would not be unreasonable to expect even stronger EU effect than the one estimated by these models.

Table 6.1: FE Model Results

	Dependent variable: log(export)		
	EU-Effect	Trade Creation	EU-Dummies
	(1)	(2)	(3)
lGDP_d	0.684***	0.686***	0.686***
	(0.016)	(0.016)	(0.016)
lGDP_o	0.658***	0.658***	0.674***
	(0.020)	(0.020)	(0.020)
ldist			
EU_o	0.302***		0.166***
	(0.025)		(0.026)
EU_d	0.143***		0.096**
	(0.034)		(0.034)
both_in		0.506***	
		(0.035)	
one_in		0.231***	
		(0.024)	
EU_lag_o			0.028
			(0.022)
EU_lag_d			−0.004
			(0.032)
EU_lag2_o			0.190***
			(0.022)
EU_lag2_d			0.082*
			(0.033)
Year FE	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes
Observations	446 679	446 679	446 679
R^2	0.868	0.868	0.868
Adjusted R^2	0.868	0.868	0.868

*p<0.1; **p<0.05; ***p<0.01

Table 6.2: PPML Model Results

	Dependent variable: exports		
	EU-Effect	Trade Creation	EU-Dummies
	(1)	(2)	(3)
lGDP_d	0.668***	0.668***	0.674***
	(0.031)	(0.030)	(0.031)
lGDP_o	0.666***	0.670***	0.672***
	(0.026)	(0.026)	(0.026)
ldist			
EU_o	0.369***		0.234***
	(0.036)		(0.025)
EU_d	0.201***		0.104**
	(0.044)		(0.037)
both_in		0.484***	
		(0.054)	
one_in		0.149***	
		(0.039)	
EU_lag_o			0.027*
			(0.013)
EU_lag_d			0.028 .
			(0.015)
EU_lag2_o			0.159***
			(0.023)
EU_lag2_d			0.100***
			(0.021)
Year FE	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes
Observations	454,031	454,031	454,031
Adj. Pseudo-R^2	0.985	0.985	0.986

*p<0.1; **p<0.05; ***p<0.01

6.3 Trade Creation & Trade Diversion

Being interested in finding out whether the EU membership causes trade creation and/or trade diversion effects it is suggested to construct and include pair of additional dummy variables into the specification, $both\_in_t$ (being equal to 1 given that both nations are members of EU in a given year) and one_in_t (being equal to 1 in case any of the nation pair being member of EU in a given year). Then estimating gravity equation to identify the signs of the parameters on both auxiliary dummies will be used in evaluating trade creation/diversion effects (Bachetta et al. 2012). **Table 6.1.** shows that both parameters on auxiliary dummy variables were significant and positive using FE model, signifying the trade creation occurrence within the membership nations. Unsurprisingly, stronger trade creating effects are observed in case both nations are members of EU, than if only one. But even one nation in EU results in increased national trade flows. Evidence of trade creation was also found using PPML model, where parameters on both dummy variables were positive and statistically significant and similar in magnitude to FE estimates (**Table 6.2**). The negative sign of parameters on these auxiliary dummies could possibly signify the trade diversion occurrence. Results of this study however, found no evidence of trade diversion caused by EU membership.

6.4 EU Lagged Effects

This section investigates estimated parameters on four additional dummy variables (EU_lag_{ot}, EU_lag_{dt}, EU_lag2_{ot}, EU_lag2_{dt}) included in the specification to obtain a rough approximation of integration benefits across time. The first pair of dummies EU_lag_{ot} and EU_lag_{dt}, representing three-years lag were both estimated to be statistically insignificant by FE model (**Table 6.1.**). PPML model produced small, positive results with a 10% significance level. These results are very small in magnitude and although statistically significant, FE model assigned no significance to these lags, thus there is little reason to assign any importance to this result. In case of second pair of lagged variables, both models produced statistically significant and positive estimates of 0.159 for EU_lag2_{ot} and 0.100 for EU_lag2_{dt} in case of PPML and 0.190, 0.082 respectively in case of FE model, though second result was of smaller statistical significance. The story behind these results would imply that the integration benefits are not yet achieved at all in the first three years of in-

tegration, although as explained in section 3. there were many nations with pre-accession period trade agreements already in place. This seems implausible, that the EU effect would be insignificant first three years after the integration and it would suddenly be after five years threshold. The explanation behind this effect is technical one - the two pairs of dummy variables were created with two years gap, which is too small for the model to properly divide the EU effect between the lagged dummies, due to high degree of collinearity. In the Appendix B the sensitivity analysis was performed to prove the aforementioned point. Thus, it is impossible to tell whether there were more benefits achieved during the first three years or five years of integration. However, based on these results it is safe to assume that EU integration is indeed continuous process and even after five years of integration there is growth in trade due to EU membership. And again, these results might imply that exporting industries are greater beneficiaries than the importing ones after five years threshold with FE model reporting more than twice as big results for EU_lag2_{ot} dummy as compared to EU_lag2_{dt} dummy and PPML model reporting also EU_lag2_{ot} to be greater by 0.059.

Chapter 7

Conclusion

The main goal of this thesis was to provide the state of art empirical results that would confirm or refute the hypotheses on whether EU has stimulative effects on international trade of its members and whether these effects are immediate or rather changing in time. The thesis itself is divided into five sections, first one is dedicated to the origins of gravity model, overview and technical specifications aided by existing research on the use of this model. In the section after, theoretical foundation is laid for the thesis providing with reasoning and existing theoretical frameworks on FTAs and integration processes. Renown theories such as Viner's trade diversion, theory of second best, and the static versus dynamic analysis approaches are discussed. Next section concerns with the theoretical analysis and evaluation of effects of FTAs and structure of the EU. Then the data gathering process and methodology applied in this thesis are revealed, continued with the next section that discusses concrete empirical results. Fixed effects and PPML models were employed as main estimation methods with country-pair time invariant dummies and time dummies.

Main contribution of this thesis constitutes the empirical analysis that was performed on a carefully crafted data set of 195 nations worldwide, using CEPII, WITS and DOTS websites for these purposes, finally consisting of 476 146 observations for a period of 1988 - 2018. Main empirical results of this thesis show that European Union indeed is trade creating and there was found positive and statistically significant correlation between EU membership and the magnitude of trade flows of membership nations. Interestingly, the results also reveal that the national flow of exports stand to benefit more from the EU membership, than the flow of imports. Although both import and export are

significantly increased due to membership in EU. Moreover the results imply that the integration is a continuous process and all the benefits from trade liberalization are not to be obtained immediately. Specifically, after first five years of membership the positive stimulative effect of EU membership was still present and significant.

Although constructing the specification in this thesis with accordance to the state of art literature on gravity models - including country-pair fixed effects and specific year dummies, the methodology is still limited by not including any time-varying effects. The inclusion of those caused omission of all the coefficients because of time-varying character of the variables of interest, which became perfectly collinear with the time-varying effects. These are useful in eliminating part of the gold medal mistake concerning the time variant character of MRTs. Moreover, it would be interesting to include more lagged EU dummy variables to see a timeline of the benefits and their magnitude, however with greater distance in time so the model is able to estimate the effect properly. Lastly, an additional analysis would be required to tell whether there really is significant difference in how exports and imports are affected by the EU membership.

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Appendix A

List of Countries Used In Estimation

1. Afghanistan
2. Albania
3. Algeria
4. Andorra
5. Angola
6. Antigua and Barbuda
7. Argentina
8. Armenia
9. Aruba
10. Australia
11. Austria
12. Azerbaijan
13. Bahamas
14. Bahrain
15. Bangladesh
16. Barbados
17. Belarus
18. Belgium
19. Belize
20. Benin
21. Bermuda
22. Bhutan
23. Bolivia
24. Bosnia and Herzegovina
25. Botswana
26. Brazil
27. Brunei Darussalam
28. Bulgaria
29. Burkina Faso
30. Burundi
31. Cabo Verde
32. Cambodia

33. Cameroon
34. Canada
35. Cayman Islands
36. Central African Republic
37. Chad
38. Chile
39. China
40. Colombia
41. Comoros
42. Congo, Rep.
43. Costa Rica
44. Cote d'Ivoire
45. Croatia
46. Cuba
47. Cyprus
48. Czech Republic
49. Denmark
50. Djibouti
51. Dominica
52. Dominican Republic
53. Ecuador
54. Egypt, Arab Rep.
55. El Salvador
56. Equatorial Guinea
57. Eritrea
58. Estonia
59. Eswatini
60. Ethiopia
61. Faroe Islands
62. Fiji
63. Finland
64. France
65. French Polynesia
66. Gabon
67. Gambia
68. Georgia
69. Germany
70. Ghana
71. Greece
72. Greenland
73. Grenada
74. Guatemala
75. Guinea
76. Guinea-Bissau
77. Guyana
78. Haiti
79. Honduras
80. Hong Kong SAR, China
81. Hungary
82. Iceland

83. India
84. Indonesia
85. Iran, Islamic Rep.
86. Iraq
87. Ireland
88. Israel
89. Italy
90. Jamaica
91. Japan
92. Jordan
93. Kazakhstan
94. Kenya
95. Kiribati
96. Korea, Rep.
97. Kuwait
98. Kyrgyz Republic
99. Lao PDR
100. Latvia
101. Lebanon
102. Lesotho
103. Liberia
104. Libya
105. Lithuania
106. Luxembourg
107. Macao SAR, China
108. Madagascar
109. Malawi
110. Malaysia
111. Maldives
112. Mali
113. Malta
114. Marshall Islands
115. Mauritania
116. Mauritius
117. Mexico
118. Micronesia, Fed. Sts.
119. Moldova
120. Mongolia
121. Morocco
122. Mozambique
123. Myanmar
124. Namibia
125. Nauru
126. Nepal
127. Netherlands
128. New Caledonia
129. New Zealand
130. Nicaragua
131. Niger
132. Nigeria

133. North Macedonia
134. Northern Mariana Islands
135. Norway
136. Oman
137. Pakistan
138. Palau
139. Panama
140. Papua New Guinea
141. Paraguay
142. Peru
143. Philippines
144. Poland
145. Portugal
146. Qatar
147. Russian Federation
148. Rwanda
149. Samoa
150. San Marino
151. Sao Tome and Principe
152. Saudi Arabia
153. Senegal
154. Seychelles
155. Sierra Leone
156. Singapore
157. Slovak Republic
158. Slovenia
159. Solomon Islands
160. Somalia
161. South Africa
162. Spain
163. Sri Lanka
164. St. Kitts and Nevis
165. St. Lucia
166. St. Vincent and the Grenadines
167. Sudan
168. Suriname
169. Sweden
170. Switzerland
171. Syrian Arab Republic
172. Tajikistan
173. Tanzania
174. Thailand
175. Togo
176. Tonga
177. Trinidad and Tobago
178. Tunisia
179. Turkey
180. Turkmenistan
181. Turks and Caicos Islands
182. Tuvalu

183. Uganda
184. Ukraine
185. United Arab Emirates
186. United Kingdom
187. United States
188. Uruguay
189. Uzbekistan
190. Vanuatu
191. Venezuela, RB
192. Vietnam
193. Yemen, Rep.
194. Zambia
195. Zimbabwe

Appendix B

Sensitivity Analysis on Lagged EU Variables

Purpose of this appendix is to show that EU lagged variables are indeed wrongly estimated if included in the same specification at once. The model does not properly estimate such specification because the dummy variables were created with only 2 years gap. **Table B.1.** and **Table B.2.** prove aforementioned reasoning. In second specification the EU_lag_o and EU_lag_d are statistically very significant and positive in both PPML and FE models. However if included with EU_lag2_o and EU_lag2_d in the fourth specification, EU_lag_o and EU_lag_d become absolutely insignificant in FE model and not very significant as estimated by PPML model. There is no reason to think that first three years of integration remain with no relevant benefits and only after five years the benefits start to show - as it would be suggested by the fourth specification in both models.

Table B.1: FE - Dummy Variations

	Dependent variable: log(export)			
	EU Effect	First Lag	Second Lag	Both Lags
	(1)	(2)	(3)	(4)
lGDP_d	0.684***	0.685***	0.686***	0.686***
	(0.008)	(0.008)	(0.009)	(0.009)
lGDP_o	0.658***	0.666***	0.674***	0.674***
	(0.010)	(0.010)	(0.010)	(0.010)
ldist				
EU_o	0.302***	0.164***	0.178***	0.166***
	(0.014)	(0.020)	(0.017)	(0.020)
EU_d	0.143***	0.095***	0.094***	0.096***
	(0.017)	(0.025)	(0.021)	(0.025)
EU_lag_o		0.182***		0.028
		(0.019)		(0.026)
EU_lag_d		0.063***		−0.004
		(0.024)		(0.033)
EU_lag2_o			0.206***	0.190***
			(0.016)	(0.022)
EU_lag2_d			0.080***	0.082***
			(0.020)	(0.028)
Year FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes
Observations	446 679	446 679	446 679	446 679
R^2	0.876	0.876	0.876	0.876
Adjusted R^2	0.868	0.868	0.868	0.868

*p<0.1; **p<0.05; ***p<0.01

Table B.2: PPML - Dummy Variations

	Dependent variable: export			
	EU Effect	First Lag	Second Lag	Both Lags
	(1)	(2)	(3)	(4)
lGDP_d	0.668***	0.671***	0.675***	0.675***
	(0.031)	(0.031)	(0.031)	(0.031)
lGDP_o	0.666***	0.668***	0.672***	0.672***
	(0.026)	(0.026)	(0.026)	(0.026)
ldist				
EU_o	0.369***	0.232***	0.247***	0.234***
	(0.036)	(0.025)	(0.027)	(0.025)
EU_d	0.201***	0.103**	0.117**	0.104**
	(0.044)	(0.037)	(0.038)	(0.037)
EU_lag_o		0.164***		0.027*
		(0.024)		(0.013)
EU_lag_d		0.115***		0.0279 .
		(0.025)		(0.015)
EU_lag2_o			0.173***	0.159***
			(0.025)	(0.023)
EU_lag2_d			0.115***	0.101***
			(0.024)	(0.021)
Year FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes
Observations	454 031	454 031	454 031	454 031
Adj. Pseudo-R^2	0.986	0.986	0.986	0.986

*p<0.1; **p<0.05; ***p<0.01