# Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies


MASTER'S THESIS

# Observing Globalization using the Gravity Model of Trade


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Supervisor: **Mgr. Michal Paulus**


Academic Year: **2015/2016**

## Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, May 12, 2016

Signature

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# Abstract

This thesis investigates application of the gravity model of international trade on measuring a distance coefficient, which is known to be a proxy to globalization. This estimation is performed on a dataset containing information on EU 27 countries through the years 1996 to 2014. The presence of 10 post-communist countries enabled the author to perform the estimation on transformative economies, which had been isolated from their western trade partners for over 40 years. The division of the dataset into the Western and Eastern Blocs enabled measurement of convergence of the intra-blocs trade – the second goal of this thesis. This measurement was done through newly introduced intra-blocs trade variables that enabled measurements of both directions of trade. Through the application of this model on 10 sections, these measurements could be performed on single trade components. The analysis shows a substantial heterogeneity between single sections both in distance coefficient and inter-blocs trade. An increase in the level of globalization was observed in 9 out of 10 sections and convergence of some sections between the blocs was also found. Finally, globalization was found to progress with varying speed within single SITC sections during periods of economic crises.

**JEL Classification** F14, F15, F17, F47, F60, F63
**Keywords** globalization, gravity model, disaggregated trade, distance coefficient, multilateral resistance

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# Abstrakt

Tato diplomová práce se zabývá aplikací gravitačního modelu mezinárodního obchodu na měření vývoje globalizace prostřednictvím distančního koeficientu. Popsané měření je prováděno mezi státy Evropské unie v letech 1996 a 2014. Přítomnost 10 postkomunistických států nám umožnila měřit tento vývoj na transformačních ekonomikách, které byly po 4 dekády odtrženy od svých západních partnerů. Rozdělení datasetu na tyto dva bloky nás přivádí k dalšímu cíli práce, kdy měříme konvergenci vzájemného obchodu mezi západním a východním blokem nově představenými binárními proměnnými meziblokového obchodu. Aplikace tohoto modelu na 10 SITC sekcí nám umožňuje provést tato měření na jednotlivé složky zahraničního obchodu. Tato analýza potvrdila značnou heterogenitu jednotlivých sekcí jak u vývoje distančního koeficientu, tak i u vývoje meziblokového obchodu. Zvýšení úrovně globalizace jsme zaznamenali u 9 z 10 sekcí, dále jsme u některých sekcí zaznamenali konvergenci mezi jednotlivými bloky. Analýza dále prokázala různou senzitivitu úrovně globalizace jednotlivých sekcí na ekonomické krize.

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| **Klasifikace JEL** | F14, F15, F17, F47, F60, F63 |
| **Klíčová slova** | globalizace, gravitační mode, disagregovaný obchod, distanční koeficient, mnohostranná resistence |

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# Acronyms

| | |
|---|---|
| **CARA** | Constant Absolute Risk Aversion |
| **CES** | Constant Elasticity of Substitution |
| **EU** | European Union |
| **FDI** | Foreign Direct Investment |
| **GDP** | Gross domestic product |
| **GM** | Gravity Model |
| **HS** | Harmonized System |
| **ISIC** | International Standard Industrial Classification |
| **MRT** | Multilateral Resistance Terms |
| **OLS** | Ordinary Least Squares |
| **PPML** | Poisson Pseudo-Maximum Likelihood |
| **PQL** | Poisson Quasi-Likelihood |
| **RTA** | Regional Trade Agreement |
| **SITC** | Standard International Trade Classification |

# Master's Thesis Proposal

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|---|---|
| **Author** | Bc. Adam Dobiáš |
| **Supervisor** | Mgr. Michal Paulus |
| **Proposed topic** | Observing Globalization using the Gravity Model of Trade |

**Topic characteristics** Globalization is a phenomenon that has an indisputable effect on almost every person and every economy in the world through its impact on GDP. Due to this reason observation of the level of globalization is very interesting as it brings an important evidence for policy makers. Using recently developed gravity model techniques I want to observe the level of globalization through the distance coefficient that is known as its proxy. First I would like to describe the methods I will use for the estimation and a recent progress in the gravity model theory. Second I would like to create a dataset of disaggregated bilateral trade flows, countries' GDPs, regional trade agreements, institutional foundations and supporting explanatory variables. Third I would like to apply described techniques on this dataset and observe a different paths of distance coefficient evolution between them and try to find any empirical explanation for such evolution. Further I am interested in a measurement of the unexamined correlation between coefficients of two sets of explanatory variables – the aggregated and the disaggregated

**Hypotheses** The main hypothesis we want to prove is if the level of globalization has increased in all the observed sections of trade. Also we want to find out if the sections of trade provide evidence of convergence between the Eastern and Western Bloc over the time. Third we want to test if the Great Recession had negative impact on the level of globalization.

**Methodology** For the analysis we will use a micro-founded gravity model, where the multilateral resistance terms will be approximated using Taylor-series expansion model of Baier & Bergstrand (2009). For the observation of intra-bloc trade we will introduce a intra-bloc trade dummy variables. Subsequently the data will be cross-sectionally year by year estimated using Poisson Pseudo Maximum Likelihood estimator proposed by Santos Silva & Tenreyro (2006).

### Outline

1. Introduction
2. Theoretical Background and Literature Review
3. Empirical Research
4. Estimation Results
5. Discussion
6. Conclusion

### Core bibliography


1. Bacchetta, M. et al. (2012): "A Practical Guide to Trade Policy Analysis." *WTO*: pp. 236.
2. Baier, S.L. & J.H. Bergstrand (2009): "Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation." *Journal of International Economics* **77(1)**: pp.77–85.
3. Santos Silva, J.M.C. & S. Tenreyro (2006): "The Log of Gravity." *The Review of Economics and Statistics*, **88(4)**: pp.641–658.
4. Shepherd, B. (2012): "The Gravity Model of International Trade: A User Guide." *United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)*: pp. 76.
5. Siliverstovs, B. & D. Schumacher (2008): "Disagregated Trade Flows and the "Missing Globalization Puzzle" ." *Économie internationale*, **115**: pp. 141-164.


Author Supervisor

# Chapter 1

# Introduction

Globalization is a phenomenon of the last few decades that directly affects the life of almost every person and every economy on the world. International Monetary Fund (2000) defines globalization as not only of the movement of people, spread of knowledge and capital movement, but also development of trade. As globalization is an indisputable driver of GDP and quality of life, it is extremely interesting to observe and very important in policy setting as well.

The objective of this thesis is to apply a new way to observe globalization. To do so, we have decided to utilize properties of the gravity model, an acknowledged trade analysis workhorse. Here one of the most crucial explanatory variables is the distance coefficient, which is known as a proxy of level of globalization and whose application as this proxy was recently enabled by new progress in gravity model theory such as Siliverstovs & Schumacher (2008). In this thesis we apply a new application of the distance coefficient and, observing its yearly evolution, we use it as a globalization development proxy. This application provides us a new insight into the development of the level of globalization.

Globalization and trade, which are also represented by quality of infrastructure, communication, non-monetary barriers, but also by taste differences and insecure contracts, are interesting to observe dynamically on a set of diverse countries. To do so we have decided to perform the observation on transitive economies, which have for 4 decades been economically isolated from nearby countries. These conditions have been present for the past 25 years after the breakup of the Eastern Bloc when Central and Eastern European Countries reoriented from east to west and entered the European Union. Hence we select the EU 27 countries and observe them using a gravity model on disaggregated trade flows in the period from 1996 to 2014. A further goal is to observe the developing trade between these two blocs. In order to do so, we will modify the traditional dummy variable used for trade within historically related country-pairs to create an inter-bloc trade dummy. Subsequently we will separate this dummy to account for both directions of trade. Observation of these dummies will allow us to see how the trade between the blocs developed and to see if inequality between these two blocs still persists. Thanks to the disaggregated trade flows approach, we can observe the evolution of the intra-blocs trade and of the level of globalization not only per whole economy but also within single trade sections.

In the estimation, the multilateral resistance terms are approximated using Taylor-Series Expansion model introduced by Baier & Bergstrand (2009) and the estimations are done using the Poisson Pseudo Maximum Likelihood estimator popularized by Santos Silva & Tenreyro (2006). Subsequently a comparison of single trade sections can be done and a heterogeneous distance coefficient evolution and different convergence paths among the sections observed. As well as that, we will observe variability in the sensitivity to recessions. We hope that this observation brings us new insights and interesting findings about the adaptability of single sections to new market conditions and recessions and about the degree of globalization of single sections.

The thesis is structured as follows: Chapter 2 introduces the theoretical background for the gravity models and the issues that are present and later debated in empirical research. Chapter 3 discusses the dataset and methodology used for the estimation. Chapter 4 presents and summarizes results from the estimators and discusses the appropriateness of individual estimators. Chapter 5 discusses the results, their implications and proposes further research questions. Chapter 6 summarizes the findings of this thesis.

# Chapter 2

# Theoretical Background and Literature Review

## 2.1 Introduction to the Gravity Models

The gravity model of trade was invented by Dutch economist and a Nobel Prize winner Jan Tinbergen in 1962 and soon became popular and broadly used due to its success in empirical application. The original intuition is very straightforward. Tinbergen tried to apply the well-known Newton's law of universal gravitation (2.1) to the international trade data.

$$F_{1,2} = G\frac{m_1 m_2}{r^2} \tag{2.1}$$

In the equation he substituted masses of objects $m_1$, $m_2$ for the size of single economies, that are usually represented by the value of country's GDP. In the coefficient of the distance between the centers of the masses $r^2$ he extracted the square root as he was expecting a linear effect of the distance. The intuition that large countries trade more and that more distant countries trade less let Tinbergen to a surprisingly statistically significant result[1].

This success subsequently led Tinbergen's followers to further develop the model as well as extend the model with additional elements of international movement such as capital flows or migration of people. Eventually gravity models started being used to measuring the economic impact of various policies such as entering a trade union, forming of a monetary union, enforcing the impact of economic sanctions on trade (Caruso, 2003) or a simple measure

[1] $R^2$ coefficients usually exceeds value 0.5 even in the most basic forms of the gravity model.

of an effect of imposition of tax (Solleder, 2013). A gravity model can also be applied on time-series, cross-sectional or panel data and an evolution of various explanatory variables over time can be observed. These more advanced techniques will be discussed later on. The following section will follow the evolution of the gravity models from the initial model to the current ones.

## 2.2 Evolution of the Gravity Models

### 2.2.1 Intuitive Gravity Model

The intuitive gravity model invented by Tinbergen (1962) can be mathematically denoted as follows:

$$logX_{ij} = \alpha + \beta_1 logGDP_i + \beta_2 logGDP_j + \beta_3 log(distance_{ij}) + e_{ij} \qquad (2.2)$$

where $X_{ij}$ stands for the exports from country $i$ to country $j$. $GDP_i$ and $GDP_j$ indicates the values of gross domestic products of the country $i$ and country $j$. The geographical distance between the economical centers of both countries is represented by value $distance_{ij}$. $\alpha$ is the regression constant, $e_{ij}$ is the random error term and betas are the estimations coefficients. All the values are given in a logarithmic form, because Newton's original gravity equation contains multiplication and a division, which cannot be solved econometrically, leading us to the necessity of logarithmic transformation.

This most basic model is usually enhanced by a set of dummy variables that have an influence on bilateral trade. The most frequent dummy variables are, for instance,such as *Common Language, Common Border, Colonial Relations, Access to Sea, Ever in Colonial Relationship, Both Countries in Trade Union* among others. These dummies represent cultural and geographical barriers which work as barriers to trade. Their inclusion into the model provides an additional explanation of possible unusual amount of bilateral trade and further increase in the significance of the model. For example, many empirical studies have proven that a common language increases international trade between the countries as there are deeper links between the countries, which creates better environment for business. Some dummy variables such as currency union greatly affect the amount of international trade.

### Issues with the Intuitive Gravity Model

The mechanism of the model is highly intuitive. Bigger countries produce more, so they also trade more and it is not surprising that the amount of trade between two given countries decreases with increased distance between them. Despite the unquestionable strengths of the original model, the intuitive gravity model is not flawless. The following section is discussing various problems of the intuitive gravity model.

In the beginning, the model struggled with a lack of theoretical basis. Dissenters declared the gravity model simply an econometric tool without any theoretical background as it did not fit the assumptions of theories most widely recognized at the time - the Ricardian theory of international trade and the Heckscher-Ohlin model. The Ricardian theory predicted differences in technologies among the countries and the Heckscher-Ohlin model assumed the abundance and scarcity of factors of production and equality of prices of traded goods among the countries, but neither of the models made any predictions about the size of the countries and their distances from each other.

The first person who provided a gravity model with theoretical background, was Anderson (1979). He assumed that each country produces differentiated goods and that consumers possess "love of variety". These two assumptions imply that, independently of the price of the product, varieties consumers will consume at least some of every product from every country. A consequence of this implication is that all countries participate in international trade and all goods are being traded.

In equilibrium situation the national income equals the sum of foreign and domestic demand for the domestically produced good. And due to this fact, larger countries export and import more than smaller countries. Since imports are measured at the Cost, Insurance, Freight method and trade costs operates within the Iceberg costs mechanism, the value of imports decreases with the distance or increase of trade costs.

Another significant contribution for the theoretical background of the gravity model was brought by Bergstrand (1989), who showed that the gravity model is implied by Krugman's monopolistic competition model where differentiated goods are traded between identical countries because of consumers' love of variety. The monopolistic competition framework also determines the geographical differentiation of products by location and the fact that different countries specialize in production of different sets of products. Furthermore the intuitive gravity model omits some important mechanisms that also play a role in the country's inclination to trade. These are discussed below.

Imagine a situation in which international trade of three countries was observed. What will happen in case of decrease in transportation costs between two of the countries? The transportation costs may decrease for various reasons, such as the improvement in infrastructure or the forming of a trade agreement. According to a normal economic theory, if the mutual prices of the goods decreased, that would lead to an increase in consumption and thus to an increase in mutual trade. But the prediction of the intuitive gravity model would not change. This can be seen clearly from the equation (2.3) below.

$$\frac{\partial log_{ij}}{\partial log(distance_{ij})} = 0 \tag{2.3}$$

Also the model can mispredict in a situation when there is an equal decrease in trade costs across all trade routes including domestic ones — goods that are produced and sold internally. This situation might arise when there is, for instance, a decrease in a price of oil, which cuts down the transportation costs everywhere. The prediction of the intuitive gravity model would be that a proportional increase in an international trade will occur despite the fact that relative prices will stay the same.

### 2.2.2 Modern Gravity Models

Since the intuitive gravity model — despite its imperfections — has proven itself empirically very successful, many researchers tried to improve the model in order to eliminate these problems. One of the most reputable models are the Gravity with Gravitas model of Anderson & van Wincoop (2003), that truly meant a revolution in the gravity model theory. Anderson & van Wincoop (2003) have based their version of gravity model on a microeconomic theory from which is their model called micro-founded or structural gravity model. Since the time of Anderson & van Wincoop (2003) all further versions of gravity model, such as the Gravity Model with Dummies of Baldwin & Taglioni (2006) or the Taylor-Series Expansion Gravity Model of Baier & Bergstrand (2009), have been based on the microeconomic theory and they include some modification of multilateral resistance terms.

The Gravity with Gravitas model can be considered a foundation stone of the modern gravity model approaches, as Anderson & van Wincoop (2003) implemented a demand function into the gravity model. Specifically, their gravity model incorporates a modification of constant elasticity of substitution function, which represents consumers' "love of variety" preference. In other words according to the Gravity with Gravitas the consumers' utility increases from consuming either from wider variety of goods or from consuming more of a given good. Their production side stands on the assumptions of Krugman (1979) that each firm is a producer of a single, unique product. The firms exhibit increasing returns to scale. Krugman assumes a large number of firms in the industry where the firms charge constant mark-up pricing that is in equilibrium exactly as high as to cover their fixed costs, which are related to the market entry.

The goods can be sold either on the home market or on the foreign market. Selling on the home market is not connected with any additional costs whereas in order to sell on a foreign market additional transportation costs have to be paid. This model, as well as most of the gravity models, works with iceberg transportation costs that charge for a unit sold on the foreign market an additional fraction of the unit.

As a result, if the good is exported its price is higher than if it's sold domestically. The consumers consume products from all countries but the price of imports reflects the costs of transportation. It is assumed that the transportation costs are symmetric. This means that the costs of transportation from country $i$ to country $j$ are equal to the opposite direction, $\tau_{ij} = \tau_{ji}$. The transportation costs consist not only of the cost of transport itself but also of the information, design, legal and regulatory costs, etc. It is assumed that these costs are defrayed by the exporter. In the model there are initially determined firms that are involved in the international trade and their volume of exports is calculated. The exports of single firms are summed up in order to obtain a country's total value of exports.

So how does the Gravity with Gravitas model solve the above mentioned issues of the Intuitive gravity model? Anderson & van Wincoop (2003) have included two additional variables $\Pi_i^k$ and $P_j^k$ into their model. The outward multilateral resistance denoted as $\Pi_i^k$ captures the fact that exports from country $i$ to country $j$ are dependent on trade costs across all possible exporting countries. The inward multilateral resistance denoted as $P_j^k$ captures the fact that imports into country $i$ from country $j$ are dependent on costs of import from other possible markets.[2] Basically $P_j$ is a consumer price index that is

[2] These relations are symmetric due to the above discussed fact that $\tau_{ij} = \tau_{ji}$.

dependent on the transportation costs on all bilateral routers.[3] If there were no transportation costs at all (for every $i$,$j$ $\tau_{ij} = 1$) the price indices will be equal to one in every country. These two additional terms are Anderson's and Van Wincoop's solution to the intuitive gravity model problems Shepherd (2012). For the purpose of clarity of the Gravity with Gravitas sectoral model's mathematical notation is stated below.

$$\Pi_i^k = \sum_{j=1}^{C} \left\{ \frac{\tau_{ij}^k}{P_j^k} \right\}^{1-\sigma_k} \frac{E_j^k}{Y^k} \tag{2.4}$$

$$P_j^k = \sum_{i=1}^{C} \left\{ \frac{\tau_{ij}^k}{\Pi_j^k} \right\}^{1-\sigma_k} \frac{Y_i^k}{Y^k} \tag{2.5}$$

$$\begin{aligned} logX_{ij}^k &= logY_i^k + logE_j^k - logY^k \\ &+ (1-\sigma_k)[log\tau_{ij}^k - log\Pi_i^k - logP_j^k] \end{aligned} \tag{2.6}$$

where $X_{ij}^k$ is the amount of export in sector $k$ between countries $i$ and $j$, $Y^k$ is the world GDP in the sector $k$, $E_j^k$ is the expenditure of country $j$ in sector $k$ and the $\sigma_k$ is the intra-sectoral elasticity of substitution between varieties of products and the $\tau_{ij}^k$ is transportation cost between the countries in an observed sector $k$.

The merit of the multilateral resistance terms is that they represent relative costs of transportation between all countries. Therefore once there is a change of costs on one bilateral route a change in relative costs on all other bilateral routes occurs. The multilateral resistance terms together with the distance coefficient represent the total costs of transportation between country $i$ and country $j$.

In other words, Anderson & van Wincoop (2003) proved that the determinants of a trade between countries are the relative trade barriers. For example ceteris paribus bilateral trade between the Czech Republic and Austria would be much higher if the countries were situated on an island in the middle of an ocean than it is now when the countries are surrounded by multiple other economies. It is precisely this kind of information that the multilateral resistance terms take into account. If the country is remote from the world markets, the

[3] If TC on all bilateral routes increase even the index increases.

multilateral resistance terms are low.[4] Anderson & van Wincoop (2003) have brought three implications:

- "*Implication 1*: Trade barriers reduce size-adjusted trade between large countries more than between small countries."
- "*Implication 2*: Trade barriers raise size-adjusted trade within small countries more than within large countries."
- "*Implication 3*: Trade barriers raise the ratio of size-adjusted trade within country 1 relative to size-adjusted trade between countries 1 and 2 by more the smaller is country 1 and the larger is country 2."

A further contribution of the theoretical gravity model was a description of the guidelines to carry out a theoretical gravity model research. The recommendations were that in the dataset the trade flows have to be in a unidirectional form - each line in the dataset represents a single flow.[5] The theory also suggests that the trade flows should be denominated in nominal terms. This is due to the fact that the nominal values are being effectively deflated by the multilateral resistance terms, which are unobservable price indices. The denomination in real values might lead to misleading results of the multilateral resistance terms, because once the nominal values are already deflated either by the consumer price index or by the GDP deflator further deflation will lead to misleading results. Deflating by multilateral resistance terms is more efficient than by any other deflator. Due to the same reason the GDP data in the dataset should be in a nominal terms as well. The GDP should be denoted as aggregate GDP and not as a GDP per capita (Shepherd, 2012).

Theoretical gravity models usually express transportation costs as a function of geographical distance and a set of dummy variables, which represent various forms of barriers to trade. In the prevalent form, the dummies are: common official language (*comlang*), common borders (*contig*), colonial relationship (*colony*) and a variable of "being colonized by the same power" (*comcolony*). However this is just a usual custom based on many empirical observations and

[4]The remoteness term does not reflects only the distance of the country but generally its barriers of trade that can be represented by factors such as the political situation of the country or the level of its tariff barriers. An extreme example the multilateral resistance terms of North Korea are much lower than South Korean ones although the geographical location of both countries is almost the same.

[5]In example line x represents exports from country $i$ to country $j$ and line y represents exports from country $j$ to country $i$.

researchers usually search for the set of explanatory variables that is the most appropriate for their dataset. As can be seen in the equation 2.7 below the dependent variable and the variable of distance are in logarithmic form.

$$\begin{aligned} log\tau_{ij}^{k} &= \alpha + \beta_1 log(distance_{ij}) + \beta_2 combord \\ &+ \beta_3 comlang + \beta_4 colony + \beta_5 comcolony \end{aligned} \tag{2.7}$$

### Issues of the Gravity with Gravitas Model

From this point of view, the Gravity with Gravitas model seems to be flawless as it possesses with theoretical background and the multilateral resistance terms efficiently remedy the issues and mispredictions of the previous intuitive model, but there is a serious issue with the multilateral resistance terms that decreases the empirical usage of the model. The main issue is that the multilateral resistance terms are directly unobservable and they have to be estimated. There are several methods how to estimate them. One of the simple ones is to use a "remoteness" variable as a proxy for the multilateral resistance terms.

Another drawback of the Anderson and Van Wincoop's model is that the model works only on cross-sectional data. Furthermore an endogeneity problem can be also present, that is most likely to appear in case of an observation of effects of trade agreements. It can be presumed for countries that are forming trade agreement, are proximate to each other and have already traded a lot before. If this presumption holds the trade agreement, the dummy variable will be correlated with the error term and there will be an upward-sloping bias.

It is not easy to solve the endogeneity problem. If the data set is in panel data format, a fixed effect model can remove the time invariant endogeneity, but the time variant endogeneity will be still present. Instrumental variables can also be used but it is hard to find variable of this type that is correlated with the trade agreement and not correlated with trade. An alternative solution to this issue is to use Generalized Method of Moments estimator.

As is stated above, the Gravity with Gravitas model caused a breakthrough in gravity model theory. It is not a surprise that after its publication many new gravity model approaches appeared. The two most recognized ones are the Gravity Model with Dummies by Baldwin & Taglioni (2006) and a Taylor-Series Expansion model by Baier & Bergstrand (2009). These models are also based on microeconomic theory and they have their own approach to the multilateral resistance terms that provides a solution to some of the Gravity with Gravitas model's issues.

### Gravity Model with Dummies

Baldwin & Taglioni (2006), inspired by Anderson & van Wincoop (2003), provided a model that approaches the multilateral resistance factor in a different manner. Instead of the multilateral resistance terms $\Pi_i^k$ and $P_j^k$ their model includes a set of dummy variables – the time-varying country specific dummies and the time-invariant pair of dummies. Their model works with fixed effects that are represented by the country and time dummies. The merit of the dummies is that they express unobserved heterogeneity between the countries and time. On the other hand, a lot of information hidden in the data can be lost due to the dummies.

It is important to note that application of the gravity model on disaggregated trade flows brings about some serious issues, because the multilateral resistance terms varies across the sectors, since the trade costs are not constant across the sectors either. Unfortunately, the elasticity of substitution also is not constant across the sectors. A possible solution to this issue is to add to the model sectoral dummies as well. This apparently straightforward solution may become difficult to execute if there is a high number of sectors in the data. It is possible to solve this problem performing an estimation for each sector setely since the multilateral resistance terms and elasticity of substitution would be estimated uniquely for each sector.

It is convenient to compare the fixed effect estimates with estimates of other estimators. Once there is compared Gravity Model with Dummies with other gravity model approaches a higher $R^2$ coefficient can be expected. But this fact should be attributed to the higher number of explanatory variables rather than to a better fit of the model.

It is convenient to note that the Anderson and Van Wincoops's (2003) model performs only if the dataset is in the cross-sectional form. On the contrary, this modification enables one to work with panel data. The advantage of panel data is that the fixed effects estimator reduces the bias that is caused by heterogeneousness of countries and also panel data are better when dealing with zero observations.

Further contribution to the gravity model literature of Baldwin and Taglioni's

(2006) paper is identification and description of three most common errors in the gravity models literature that they have named the gold, silver and bronze medal mistakes. The description of the three common mistakes is provided below.

- *Gold medal mistake:* Is the usage of logarithm of GDP or possibly any other variables as a proxy for the multilateral resistance terms. Correlation of those variables with the trade costs variable causes a bias of estimations.
- *Silver medal mistake:* Is the averaging of mutual trade between any two countries, as it is in contradiction to micro-founded gravity model. Theory suggests to treat each way trade separately.[6]
- *Bronze medal mistake:* Is the inappropriate deflation of the trade flows.[7] Since gravity is an expenditure function that allocates nominal GDP into nominal imports, this kind of inappropriate deflation is most likely to cause bias through spurious correlation. Baldwin and Taglioni (2006) further suggest that once the gold medal mistake bronze is taken care of, the medal mistake will not occur.

### Criticism of the Model

The Gravity Model with Dummies is straightforward and easily applicable, on the other hand recent criticism by Hornok (2011) shows its limits. Hornok has found that policy effects are not optimally observable on the basis the Gravity Model with Dummy variables as the set of dummies absorbs too much of the variation in the data. As a result of this, even a single policy estimation may not produce a meaningful outcome. Hornok (2011) has found that in most cases two possibilities will appear. Either the observed dummies and the country-time model's dummies are perfectly collinear and the policy is unidentifiable or, when the policy can be identified, the little amount of variation left causes the estimated coefficients to not provide meaningful information. Vicarelli *et al.* (2013) found contributing evidence to the findings of Hornak. This issue is also one of the reasons why attention of researchers is being attracted to new models such as is the Taylor-Series Expansion model by Baier & Bergstrand (2009) and others.

[6] Exports from country $i$ to country $j$ at time $t$ as one observation and exports from country $j$ to country $i$ at time $t$ as another observation.

[7] It is usually deflated by the aggregate price index in the United States.

### Taylor-Series Expansion Model

Another solution how to bypass the problem of observing the multilateral resistance terms was recently introduced by Baier & Bergstrand (2009). They have suggested that multilateral resistance terms, which they call "remoteness"[8] can be linearly approximated by the first order Taylor series expansion. A mathematical notation of their gravity model equation is presented below:

$$
\begin{aligned}
logX_{ij} = \alpha + logY_i + logY_j - (\sigma - 1)log\tau_{ij} \\
+ (\sigma - 1)[\sum_j \theta_j log\tau_{ij} - \frac{1}{2}\sum_i \sum_j \theta_i \theta j log\tau_{ij}] \\
+ (\sigma - 1)[\sum_i \theta_i log\tau_{ij} - \frac{1}{2}\sum_i \sum_j \theta_i \theta j log\tau_{ij}]
\end{aligned}
\tag{2.8}
$$

The authors have utilized the property of Taylor-series expansion in approximation of functions. Using this property of the first-order log-linear Taylor series expansion on the system of nonlinear transportation costs equation, Baier & Bergstrand (2009) estimated the multilateral resistance terms that are theoretically based and exogenous. The first term in the brackets estimates a country's individual trade costs and the second term in the brackets provides an estimation of world's trade costs. Their estimates proved to be very similar to the ones of the Gravity Model with Dummies but their model did not have to include a large set of dummies. Overall, there is no general consensus between the researchers about the best gravity model and estimator. Different researchers prefer different models and the only good recommendation is to apply more models on the dataset, in case they are applicable, and compare their estimates.

## 2.3 Advanced Gravity Model Issues

As stated above, gravity models are not flawless. Every approach faces some issues, which may cause a bias or misprediction. In addition there are also some issues that make the gravity model application even more complicated. Unfortunately so far there are no existing perfect workarounds. One of the

[8] "Multilateral resistance terms" is a term used by Anderson & van Wincoop (2003). Baier & Bergstrand (2009) use the term remoteness. These titles are generally interchangeable in the gravity model literature.

most pressing problem that affects all above mentioned models is the zero observations issue.

### 2.3.1 Zero Observations Issue

Zero observations occur when one country from the data sample does not trade with any other. In the case that aggregated trade flows in a particular way between countries, which are close to each other, zero observations are not such a big issue, as they in this case tend to be rare. However, in the yearly disaggregated trade flows observations, zero observations are a very serious issue. There is a high probability of their frequent occurrence causing significant mispredictions.

Moreover in the case of disaggregated trade, the origin of the zero observations can vary. First they can be caused by missing observations or faulty measurements. In this case, if the zero observations are randomly distributed, which is hard to control for, they can be easily dropped. Second, they can show that the character of the good is unsuitable for international transport, i.e. low shelf life products such as fresh bakery products or bulky low value goods such as cement. In this case the zero reflects a meaningful economic ground and these observations should not be dropped. Third, zero observation can arise from the fact that the production of a given good is impossible in a given country, i.e. agricultural production. Since there is no information that i.e. Czech Republic does not trade bananas with Slovakia, this information can be dropped.[9] Finally zero observation can arise as a consequence of the decision of an exporting firm, which may find target markets too costly to supply to.

Since the standard gravity model estimation is in a logarithmic form and logarithm of zero is not defined the zero observations are in the observed data sample unacceptable and they have to be somehow modified or dropped. According to Bacchetta *et al.* (2012), there are three possible approaches how to free the dataset of zeros.

The first approach drops all zero observations. This approach seems to be straightforward and easily applicable, however it is correct only if the zero trade flows in fact signify randomly distributed missing data. But if the zero observations really express zero trade, dropping them would cause the results to be inconsistent since some useful information from the dataset would be

[9] Although in large datasets of bilateral disaggregated trade would be very demanding to check for all the zeros in the sample their production possibilities in given countries.

lost. So once one is not convinced that zero observations are the cause of some randomly distributed errors in the dataset, this approach is certainly not recommendable.[10]

The second approach is to add a small constant such as 1 dollar to all of the observations before modifying them to the logarithmic form. This will free the dataset from the zero observations. However this approach may cause inconsistent estimates since it may not reflect the underlying expected values. The third approach is to use the OLS estimation of the model in levels. This approach, however, is inconsistent with the theoretically founded gravity model as it is presented in multiplicative form (Bacchetta *et al.*, 2012).

When it is assumed that zero trade flows in the dataset are genuine, there are few econometric approaches to solve this. The first approach is to use a Tobit estimator. This estimator can work in the situation when some observations are censored and denoted as a zero. In other words this estimator is suitable in a situation in which little amount of trade is rounded down to zero and also when the zero value represents that countries desirably don't trade. The Tobit estimator can be applied to trade values below some positive value that are rounded down to zero, but it is difficult to find the threshold of rounding down. Further, the accuracy of trade data varies between countries, so that some aspects of this approach are hard to justify. Moreover the Tobit estimator heavily relies on normality and homoskedasticity, unfortunately heteroskedasticity is quite usual in trade data. And in case of heteroskedasticity being present, it is questionable what the Tobit's maximum likelihood estimator really estimates. A probably more convenient approach that was introduced by Santos Silva & Tenreyro (2006) is to make the estimation using Poisson Pseudo Maximum Likelihood estimator that incorporates zero observations and moreover has several advantages over the Tobit model.

[10]For the researchers it is really difficult to distinguish the origin of the zero observation - if it is a missing observation, true zero trade or reporting error. There is no perfect way of finding this out. Unlike for the cross sectional data, at least for the panel data there is a rule of thumb to check the whole time series with the zero observation. If there is only one zero observation between positive value observations, it is probable that a reporting error is present and vice versa for the opposite case.

### Poisson Pseudo Maximum Likelihood Estimator

Not only the Poisson Pseudo Maximum Likelihood (PPML) estimator is applicable under the presence of zero observations[11], but it also is robust under the presence of heteroskedasticity in the data. This was proven by Santos Silva & Tenreyro (2011) using Monte Carlo simulations. And as standard OLS estimation under the presence of heteroskedasticity in the data can lead to biased and inconsistent estimates, Santos Silva & Tenreyro (2011) also recommend to use PPML estimator rather than OLS estimator once presence of heteroskedasticity in the data is suspected. Because since the error term in the gravity model is using OLS estimator transformed to a logarithmic form in case that there is heteroskedasticity in the data, the heteroskedasticity usually affects not only the standard errors of the estimates, but also their meters and the OLS heteroskedasticity robust standard errors cannot cover for this type of heteroskedasticity (Shepherd, 2012).

Since the fact that the estimator is pseudo-maximum, the data do not have to have the Poisson distribution. This allows the PPML estimator to be applied on the gravity model. Another desirable property of the PPML estimator is its consistency with fixed effects, which the PPML estimator is able to include in the same way as OLS estimator – by using dummy variables. A further advantage, which the PPML estimator shares with the OLS estimator, is the straightforward interpretation of their estimates.

All above mentioned desirable properties of the Poisson Pseudo Maximum Likelihood estimator lead to an increase in its popularity among researchers. Unfortunately there are also some drawbacks connected with the estimator. Some researchers have argued that PPML estimator may not be the best estimator in case of a high share of zeros in the trading matrix although it will still be a consistent estimator (Silva & Tenreyro, 2006). The situation of a high share of zeros may arise especially if one is working with disaggregated data. But generally it can be concluded that the properties of the PPML estimator are more favourable than the OLS ones. It is suggested to make the estimation using both PPML and OLS estimator and compare together their estimates.

[11] Using PPML estimator does not require to transform the dependent variable to a logarithmic form, which allows one to avoid the problem with the limited domain of logarithmic function.

### 2.3.2 Missing Globalization Puzzle

When one takes a look at the globalization progress over the last 50 years, we see that the world has shrunk, figuratively speaking. This is thanks to all of the improvements in the field of communication, such as the Internet, e-mail or cheaper international phone calls, which have significantly lowered communication costs, and also thanks to the improvements transport and the mutual recognition of certificates for goods and services. One could suggest that these improvements would become evident in better negotiation possibilities and a cheaper and faster transport of goods. These facts should subsequently have an impact on transportation costs, decreasing them significantly. This fact would lead to a decrease in the importance of distance as every kilometer of distance between the two economies will be “shorter” than it was before. But there was a widely observed fact that the importance of distance does not decrease over time as it should due to the considerably decreased trade costs. This is an economical paradox, which is called “the missing globalization puzzle”.

The first explanation for the missing globalization puzzle was brought by Siliverstovs & Schumacher (2008) who found that the missing globalization puzzle considerably disappears once the gravity model is applied on the disaggregated trade flows on industrial level. Moreover they have found that with the use of the multilateral resistance term using the Baier & Bergstrand (2009) approach, even the aggregated data provides some evidence against the missing globalization puzzle. In comparison to that, the intuitive gravity model applied on aggregated data provided no such evidence. They find the phenomenon of the missing globalization puzzle largely connected to the intuitive gravity model, which are not theoretically founded and which provide slightly different estimates than the micro-founded gravity models.

Subsequently, Siliverstovs & Schumacher (2008) suggest to apply modern gravity model approaches to the datasets, which approach showed evidence for the missing globalization puzzle when using the intuitive gravity model. Their suggestion is that the application of modern micro-founded gravity models will disprove occurrence of the puzzle in the datasets where the missing globalization puzzle was present using the techniques based on the naive gravity model.

Another explanation of the missing globalization puzzle was brought by Coe *et al.* (2002), who using a non-linear model found evidence for globalization — decrease in the importance of distance — both on the cross-sectional and panel data. This group, as well as Siliverstovs & Schumacher (2008), has criticized the intuitive log-linear gravity model approach as it does not utilize a part of the information from the trade flows datasets that may lead through biased and inconsistent estimates to the illusion of the missing globalization puzzle.

The most recent solution to the missing globalization puzzle was proposed by Yilmazkuday (2013), who suggests that this phenomenon may be caused by the fact that the log-linear model has too restrictive assumptions on constant elasticity of substitution preferences implied by the log-linear model. Yilmazkuday (2013) has empirically shown that the absolute value of distance elasticity is decreasing with the amount of trade. Once the author used the constant absolute risk aversion (CARA) preferences instead of the constant elasticity of substitution (CES) preferences a pattern of decrease of importance of distance appeared. Thanks to the above mentioned researchers, one can conclude that the missing globalization puzzle has been found using the theoretically based gravity models and it thus seems to be irrelevant research in this thesis.

### 2.3.3 Gravity Model Applied on Disaggregated Trade Flows

The aggregation sums all commodities together and since it rounds up heterogeneous development of single commodities it largely veils underlying trade flow trends and significantly decreases informational value of such models. As a result of this, a strong inclination from aggregated to disaggregated data in gravity models can be observed in the last few years. A gravity equation for disaggregated trade flows can be seen below. For brevity, only the intuitive gravity model version is given.

$$logX_{ij}^k = \alpha + \beta_1 logGDP_i^k + \beta_2 logGDP_j^k + \beta_3 log(distance_{ij}^k) + e_{ij}^k \qquad (2.9)$$

Where the new element is the index $k$ that denotes the sector for which is the equation computed. Although the application of the gravity model on disaggregated trade flows brings indisputable benefits, it also brings some serious estimation issues such as high share of zero trades and significant increase in heterogeneity, to name a few — especially when single commodity flows are being observed.

In case of policy observations, it has been empirically found that policies tend to have an effect of various magnitudes on single commodities. Due to this, observation of policy effects on aggregated data is unreasonable. Prehn & Brummer (2011) argue that even when observing aggregated trade effects, it is more suitable to perform the analysis on disaggregated data and subsequently perform a re-aggregation of the results.

Application on disaggregated trade flows was significantly promoted by the previously mentioned Siliverstovs & Schumacher (2008), who pointed out the fundamental disadvantages of application on aggregated trade flows. As the reader may remember, they found that even the intuitive gravity model improves its outcomes and is able to “find” the missing globalization puzzle.

All these benefits show us why disaggregation is an evolving trend in gravity model application. Some researchers, such as Prehn & Brummer (2011), go as far as a single commodity application. How to select the appropriate level of disaggregation and how to employ it is discussed in the following section.

### Level of Disaggregation

The level of disaggregation of the data which researchers have worked with in recent years varies significantly, and so far there is no rule of thumb to determine the optimal level of disaggregation. The more disaggregated the data is, the more difficult it is to work with it. Additionally, the higher the share of zero observations in the dataset, the more advanced the techniques that are suggested to correct them. Due to this, an in-depth disaggregation does not have to be optimal if it is not required by the research question. If need be, the researchers should choose the level of aggregation that answers their research hypothesis and does not suffer from underlying heterogeneity, yet is low enough to prevent the mentioned issues.

The disaggregation is done based on goods classification systems. The most common ones are Standard International Trade Classification (SITC), which classifies commodities, or Standard Industrial Classification of All Economic Activities (ISIC), which classifies industries. Both of these classification systems are maintained by the United Nations. Another widely used system is the Harmonized Commodity Description and Coding System, known mostly by its abbreviation Harmonized System (HS) introduced by the World Customs Organization.

According to the International Trade Centre (2016) the SITC is comparatively better for analytical purposes than the HS, since it focuses more on the economic functions of traded products. This is because it takes into account the stage of its development in which is being traded. A slight preference in SITC system can be seen in gravity researches such as Berthelon & Freund (2008) or Eaton & Kortum (2002). SITC system is in its 3rd review, which is also used in this paper, based on 10 sections, separated into 67 2-digit divisions. These are subdivided into 261 3-digit groups, 1033 4-digit groups and finally into 3121 5-digit headings.

### Single Commodity Application

The degree of disaggregation approach has already reached its limits, since some researches have gone as far as the single commodity application. Because this level has an extremely high share of zero observations[12] as well as over-dispersion, the estimator have to be chosen very cautiously. Here are some suggestions for these cases: Zero-Inflated Poisson Pseudo Maximum Likelihood, Negative Binomial Pseudo Maximum Likelihood Burger *et al.* (2009), Zero-inflated Poisson Quasi Maximum Likelihood Staub & Winkelmann (2011) or Two-Part Models[13] such as Log-Skew-Normal Two-Part by Chai & Bailey (2008).

On the other hand, this approach also offers better possibilities of analyzing the data in respect to real world single company[14] decision evidence such as opening an abroad production site or other forms of FDI. In this case, the abroad market would be supplied by a newly opened local factory, which would likely increase mutual interconnection between the markets even if a decrease in international trade were registered in the data . Such discrepancies in the data are easily traceable and explainable at this level.

Another merit of this approach is that it can easily adjust for the commodity that is being observed. For instance, if an effect of trade agreement is measured by observing a commodity whose production amount cannot be changed immediately, appropriate lag adjustment can easily be performed. In case of aggregated data, single commodity effects have to be rounded.[15]

[12]E.g. The dataset of Prehn & Brummer (2011) have contained approximately 80% of zero observations.

[13]This model estimates in the first stage with whose trading partners the country would trade and in the second stage it estimates the amount of trade.

[14]Under assumption that the company has a market share that is as high as it noticeably affects country's export data.

[15]One can argue that trade agreements are negotiated and set a long time before their roll out. However, especially in case of multilateral agreements, a high share of market participants cannot precisely estimate their effect on demand and prices. Thus the trade agreement effect may only become evident with time.

To name one application, Prehn & Brummer (2011) applied the gravity model on the intra-European piglet trade. They found that the observed data was influenced by the entry of a large hog producer, Smithfield, who have set up production plants in the new EU member countries after the enlargement. A significant decrease in overall EU hog herds and pork meat production also had an influence on the data. This kind of data explanation is nearly impossible in aggregated data observation and also highly difficult to notice in the case of less disaggregated data.

The theoretical contribution of Prehn & Brummer (2011) was to develop a procedure of selecting the appropriate model. The researchers chose Poisson Quasi-Likelihood model as the main model. As an alternative that is able to work under the same conditions, they suggested Log-Normal Two-Part model or its generalized version that can operate under skewed distributions.[16] Subsequently they compared the significance of the models' predictions and favored the PQL model, whose features provide consistency also in presence of unobserved heterogeneity and model misspecification.

### 2.3.4 Exports vs Imports Approach

Some sources such as Bacchetta *et al.* (2012) or Baldwin & Taglioni (2006) recommend to measure imports rather than exports since exports are not usually connected with the tax duties that the imports are. Thus the preciseness of imports records made by customs office tends to be higher than the preciseness of numbers of exports. A technique called "mirroring"[17] can be used to increase the preciseness of the dataset.

However, this tends to be practice in developing countries. And due to the trade agreements there have been no tax burdens between the countries, we are focusing on, that would encourage these machinations. Due to these reasons, we can conclude that the mirroring approach is redundant for the purpose of our observation.

[16] The (usually negative) skewness sometimes appears after the logaritmisation.

[17] This technique turns imports of country $j$ from country $i$ to exports from country $i$ to country $j$.

# Chapter 3

# Empirical Research

## 3.1 Research Description

This chapter presents the research itself. In the first part the research topic will be introduced. In the next sections, an overview of the historical context a description of the dataset and methodology will be presented.

### 3.1.1 Research Topic

The purpose of this research is to measure the trade development of the Post-Eastern Bloc countries which have reoriented from the Eastern-Bloc markets to the Western-Bloc in the last 25 years. Their political reorientation subsequently resulted in their entry into the European Union. This historical context allows us to observe the evolution of single trade sections adapting to new political and market conditions. The primary goal is to measure the rate of decrease of distance coefficient that is a proxy to the level of globalization. We measure it on single trade sections and subsequently compare its total change and evolution over the observed period. The speed of convergence can work as a proxy for a given section's reorientation ability to new markets driven by political change. The second goal is to observe the convergence between the Eastern and Western Blocs. Finally we want to observe the impact of the Great Recession on the level of globalization. The above points are captured by the hypotheses in figure 3.1 below.

Figure 3.1: Hypotheses

- The level of globalization has increased in all observed sections.
- The development in single trade sections hasn't followed similar patterns.
- Sections of trade provide evidence for convergence between the Eastern and Western Bloc over time.
- The Great Recession had a negative impact on the level of globalization.

A gravity model approach was selected for this research. The level of globalization within the data-sample was measured by observing the distance coefficient, since this coefficient works as a proxy to the globalization (i.e. Siliverstovs & Schumacher (2008); Yilmazkuday (2013)). This is because by distance coefficient represented trade costs encompass not only the core transportation costs but also market access, mutual recognition of products, development of bilateral infrastructure, visa requirements or entry regime policy. Successful globalization process would be expressed by a decrease in a distance coefficient.

For the purpose of observation of inter-bloc convergence a pair of specific dummy variables, namely *east_to_west* and *west_to_east*, was prepared. These variables describe how much the belongingness to one "bloc" deviates the trade to the second bloc from the intra-blocs trade. An assumption of convergence was that the values will head to zero over time disregarding the initial sign or value. As a driver of convergence, we see equalization of economic conditions, competitiveness, production technologies and standards of living. On the other hand, the New Trade Theory would suggest divergence forces led by the specialization of countries. And as the countries within the blocs have some similar characteristics, one bloc may specialize in any sections. With the above mentioned approach, we want to measure which of the tensions will have greater weight. The usual approach to measuring historical ties in gravity models is through a "colonial" dummy that describes how the country pairs benefit from their history. This historical measurement is done, for instance, by Eichengreen & Irwin (1996). In the estimation below described one could proceed identically and form "Eastern Bloc" and "Western Bloc" dummies letting the inter-bloc trade be the base state. The dummy variable is modified in an innovative way to introduce and show the inter-bloc trade, since it is not the wish to observe the evolution of the intra-bloc trade. In order to be able to observe the differences on each side of the bloc, this dummy was divided into two variables that distinguish the direction of the trade. A slight drawback of the only-EU-members set is that the observed countries are more similar and proximate in comparison with intercontinental country pairs. Thus the heterogeneity in the dataset is harder to observe and thus a lower $R^2$ and a lower significance of some variables can be presumed.

### Historical Insight

Before the effect of historical ties within Eastern and Western Bloc and their convergence is measured, let us firstly briefly summarize the main historical events that the countries have undergone in the 1990s. The focus group are countries from the Central and Eastern European region that have undergone a political and economical turnaround after local revolutions and the dissolution of the Soviet Union.

The most important year here is 1989, the year of the revolutions in Czechoslovakia, Poland, Hungary, German Democratic Republic, Romania and Bulgaria. In October 1990, the German Democratic Republic reunified with the Federal Republic of Germany. In the summer of 1991, Slovenia became an independent country after splitting from Yugoslavia. In December 1991 the dissolution of the Soviet Union into the Russian Federation and 14 Post-Soviet states was formally enacted. Hence the former strategical trade partners had disappeared and the successor of the Soviet Union, Russia, was struggling with a serious crisis. Another important date is 1993, when Czechoslovakia split into the Czech Republic and Slovakia. Meanwhile from 1991 to 1995, present day's newest EU member, Croatia, was fighting for its independence from Yugoslavia. Because war causes the breakage of trading ties with partners, it has a serious impact on a country's national product. Its factories switch to army production and the markets to which it originally exported find different suppliers Eichengreen & Irwin (1996). And even after the war, the country needs to overcome war consequences. Due to these reasons, Croatia was dropped from the analysis.

Collectively, Eastern Bloc countries had inherited many inconvenient consequences from their socialist past: severed ties with Western markets, uncompetitive industries, low GDP per capita, economies unable to compete with the western ones, plus other negative consequences of socialistic planned economies. While the Eastern Bloc formed, the Western European countries were coming together as well, mainly through the formation of organizations called European Communities and by opening of their markets to each other. The Treaty of Rome in 1957 created the European Economic Community, a cornerstone of the EU, which aimed to provide economic integration through common market and custom union. By 1993 the European Union already had a single internal market that assured free movement of goods, services, capital and persons. Former EU members were conscious of the political and economic benefits of EU expansion including the former socialistic countries. These countries received the possibility to become a member after fulfilling certain convergence criteria. The attractive political and economic benefits pushed these countries to begin the accession negotiations; meanwhile, in 1995, Austria, Sweden and Finland became new EU members. The eastern enlargement finally officially took place in May 2004 when Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovakia and Slovenia became members. Subsequently Bulgaria and Romania became members in 2007 and Croatia in 2013.

Another barrier between the former EU countries and the 2004-enlargement ones[1] was broken in December 2007 when they became implemented members of the Schengen Area. Currently, except for the United Kingdom, Cyprus, Croatia, Bulgaria and Romania all EU member states are simultaneously Schengen members.[2]

### 3.1.2 Dataset Description

For the purpose of the gravity model estimation one needs: information about the unidirectional[3] bilateral trade flows between given country pairs in a given sections and time period, countries' nominal yearly aggregated GDP values[4]

[1]Except Cyprus. Cyprus, Bulgaria, Romania and Croatia were planned to become Schengen members by mid 2016.

[2]Schengen area members are also Switzerland, Norway, Iceland and Lichtenstein participating in this agreement even though they are not a members of European Union. These countries also have access to the EU's single market through their membership in the European Free Trade Association (EFTA).

[3]Treating each direction of trade separately.

[4]The GDP is denoted in the nominal values since the deflation is, in an efficient way, done by the multilateral resistance terms that can be considered as an unobserved price index.

and a wide set of dummy variables describing given countries and relations between the country pairs for single years.

### Dataset Preparation

Our dataset was based on four sources of data that had to be merged together for the purpose of this research. The first source provided the information about exports between the country pairs of 27 European Union members[5] from the years 1990 to 2014. The source for this data is the UN Comtrade database, which is a part of World Integrated Trade Solution statistics collected by the World Bank.[6] UN Comtrade contains only non-zero observations so as a first step all missing zero observations had to be added in order to avoid loss of useful information and prevent potential selection bias.

Another source, the dataset of French Institute for International Economics (Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)), contains information about country pairs specifications. To name a few: *contig* for contignuity, *comcol* for common colonizer post 1945, *comlangoff* for common official of primary language, *dist* for the distance between the most important cities/agglomerations based on the terms of population and *distw* for the weighted distance between the two countries that takes into account the distribution of countries' economical centers. Information about the nominal GDP in observed countries was obtained from the World Bank's World Development Indicators database. Finally, the information about single regional trade agreements (RTA) namely *eu* for both partners being member of the European Union *efta* for European Free Trade Association relation *cefta* for Central and Eastern Free Trade Agreement and *eubil* for bilateral agreements with the EU was achieved thanks to the script of de Sousa (2012). In order to merge the sources of data into one table, SQL database PostgreSQL was used. The join

Deflation through price indices such as GDP deflator of Consumer Price Index could produce misleading results since it won't be able to capture the unreservedness of the MRT. Shepherd (2012)

[5]All current EU members excluding Croatia. Namely Austria, Belgium, Bulgaria, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

[6]An alternative source of the data to the UN Comtrade can be International Trade by Commodity Statistics database collected by OECD, which provides similar data in SITC Revision 3 categorization. This paid database however, suffers from technical issues when exporting large datasets, whereas UN Comtrade offers a free account offering exports up to 50 000 rows per export providing the possibility of creation of large data samples by merging single exports together. For example, our dataset was created by merging 4 UN Comtrade exports.

was based on country pair ISO mixes and country-year mixes. Subsequently for additional editing, the final table was exported into comma-separated values (csv) file and imported into the data analysis software Stata 12.0.

Another set of dummy variables has been generated subsequently. As in First, *eastern_exporter* and *easter_importer* were respectively introduced for exporting and importing countries with post-commusnistic history. The Western exporters and importers are traceable as *eastern_importer/exporter* = 0. Afterward we generated *east_to_west* for trade from the Eastern Bloc countries to the west and vice versa *west_to_east* for the opposite direction of trade. Dummy variables *intra_EMU* for trade within European Monetary Union and *landlock_imp* and *landlock_exp* for importers and exporters without an access to the sea or ocean were also created. The above obtained dummy variables for regional trade agreement were grouped into *eu* for both countries are EU members and *nonEUrta* including CEFTA (Central and Eastern Free Trade Agreement), EFTA (European Free Trade Association) or bilateral agreement with the EU.[7]

### Institutional Foundations

As was suggested by Francois & Manchin (2013), institutional foundations also play a role in the amount of trade. In line with their research, we have taken the difference between the institutions of observed country-pairs. For this purpose, a database of Index of Economic Freedom collected by The Heritage Foundation was taken. This index measures, for every country, the level of Property Rights, Freedom from Corruption, Fiscal Freedom, Government Spending, Business Freedom, Labor Freedom,[8] Monetary Freedom, Trade Freedom, Investment Freedom and Financial Freedom.

Since these indices are correlated, a principal component analysis was done. Using the Eigenvalue higher than one benchmark, three principal components were estimated. They were named $soc\_bus\_found$ (correlated mostly with property rights, freedom from corruption, business freedom, investment freedom and financial freedom ) $gov\_fisc\_found$ (correlated mostly with fiscal freedom and government freedom) and $trade\_found$ (correlated mostly with trade freedom and monetary freedom). These three components cumulatively explain more

[7]One country in the country pair is an EU member and the second one has a bilateral agreement with EU.

[8]Labour Freedom index is being measured since 2005. Due to this reason, we have omitted it from our model.)

than 53% of the variance in the data. Kaiser-Meyer-Olkin measure of sampling adequacy exceeds 0.5 value for every of the analyzed variables and its overall reaches 0.59 proving a suitability of principal component analysis on a given set of data. In order to deal with endogeneity, since an increase in trade can be driven by convergence of the institutions or convergence of the institutions can be driven by the increase in trade, the institutional foundation dummies have been lagged by one year.

Subsequently a modification of the variables had to be done. For the purpose of the estimations, the value of trade[9] and GDPs of both trade partners had to be transformed into logarithms. Finally for the purpose of the convergence speed boost in the Poisson Pseudo-Maximum Likelihood estimation the values of GDP and trade were rescaled from units of USD into millions of USD.

### 3.1.3 Qualitative and quantitative data analysis

#### Observed Sectors

Since many underlying trends and tendencies are hidden in the aggregated data, and in order to achieve better insight, this work focuses on the disaggregated trade flows. The classification system we work with is Standard International Trade Classification (SITC) in its third revision. Although a 4th revision is currently available, its data are available only for the last ca. 10 years. The level of disaggregation is level 1 digit, thus the trade is disaggregated into 10 sections whose descriptive list can be found below in table 3.1.

#### Observed period

Initially, we intended to observe the whole period between 1990 to 2015; however, the UN Comtrade did not contain a complete dataset for every exporting country, since at the beginning of the 90s several countries (i.e. Slovenia, Czech Republic or Slovakia ) did not report their exporters or they had not formed yet. At the beginning of the 1990s many exporters had no trade information and in 2015 there was no data available for when the research had started. Especially export data for Belgium and Luxembourg is only available starting 1999. Cutting the observed time period would lead to losing too much information from the most interesting period — the beginning of the transition.

[9]The value of trade is being used in its log-form only under OLS estimator.

Table 3.1: SITC sections overview

| Section's number | Section's name |
|---|---|
| 0 | Food and live animals |
| 1 | Beverages and tobacco |
| 2 | Crude materials, inedible, except fuels |
| 3 | Mineral fuels, lubricants and related materials |
| 4 | Animal and vegetable oils, fats and waxes |
| 5 | Chemicals and related products, n.e.s. |
| 6 | Manufactured goods classified chiefly by material |
| 7 | Machinery and transport equipment |
| 8 | Miscellaneous manufactured articles |
| 9 | Commodities and transactions not classified elsewhere in the SITC |

*Source:* United Nations

As the data for other countries was available already from 1995, we decided to observe period of 1995–2014. Thus the generated zero trade exports from Belgium and Luxembourg till 1999 have been dropped from the dataset in order to prevent inconsistencies and bias in the estimation. The Index of Economic Freedom is dated from 1995, but because of the one year lag needed in order to deal with the endogeneity, we were forced to drop the year 1995 and finally observe the period of 1996 to 2014.

#### Dispersion

Statistical dispersion is a state which denotes how stretched or squeezed the distribution within the dataset is. Often an over-dispersion, state when variance is higher than mean is present in the trade datasets. In this dataset, significant evidence of over-dispersion was also found – variance was nearly 8 000 times higher than the mean.

## 3.2 Methodology

Considering the micro-founded gravity models that are in line with the latest gravity model research theory, one basically has two models to choose from: either the dummy variable fixed-effect model known as Gravity Model with Dummies introduced by Baldwin & Taglioni (2006) or the Taylor-Series Expansion Model proposed by Baier & Bergstrand (2009), which approximates unobservable multilateral resistance terms.

The common approach is to carry out the regression with both of these models and to compare them. In our case, however, Baldwin's model would be unsuitable due to the fact that the model takes too much of the variation from the dataset through the each country and year dummies and thus its estimation over time would not bring any evidence of globalization or convergence of observed blocs. Important notes on the applicability of this model and its absorption of variation are provided by Hornok (2011). Further criticism of this model can be found in subsection 2.2.2. Since the model with dummies cannot be applied in this investigation, the only applicable model for our research is the Taylor-Series Expansion Model introduced by Baier & Bergstrand (2009).[10]

In order to implement this model, one first needs to compute the unobserved multilateral resistance terms (MRT) using Taylor-series expansion. This needs to be computed for the distance variable and for further explanatory variables used. When the MRT is being computed in case of the disaggregated trade flows, it would best suit the theory to estimate it through a single country section's total expenditure and output. Unfortunately, this information usually is not recorded and it is impossible to obtain it. Thus a proxy has to be used instead. Shepherd (2012) states that a country's GDP fits as an acceptable proxy. This approach has been used in estimation below as well.

### 3.2.1 Estimators

The Baier and Bergstrand's gravity model offers mainly a theoretical foundation for the model. Nevertheless, subsequent estimator decision and precise model specification is substantially loose. The estimators we have chosen from are discussed below.

#### Ordinary Least Squares Estimator

The gravity model estimation can be done by using the basic Ordinary Least Square (OLS) estimator. However OLS properties can be largely restrictive for the typical gravity model estimation, especially if applied to disaggregated data. In order for the OLS estimates to be unbiased and consistent, assumptions of

[10] It would be possible to perform the naive gravity model estimation, but there are some drawbacks which question its prediction capabilities. A fuller discussion of this topic can be found in subsection 2.2.1.

linearity, sample variation, random sampling and zero conditional mean have to be fulfilled. In order to be best linear unbiased estimator, the conditions of homoskedasticity, no serial correlation and normal distribution of errors also have to be held.

Heteroskedasticity is however widely present in the trade data. To deal with the possible presence of some forms of heteroskedasticity and to correct for possible violation of the homoskedasticity assumption a heteroscedasticity, consistent errors have been estimated both in the OLS and the PPML estimation. However in the case of the OLS application, the robust covariance matrix estimator cannot cover for this kind of heteroskedasticity since the potentially heteroskedastic original standard error $e_{ij}^{k}$ is for the purpose of the gravity equation transformed into logarithmic form (Shepherd, 2012).

For the OLS estimator the gravity equation needs to be in logarithmic form since as in the basic equation 2.1, there is multiplication and division in the equation and in the case of the OLS estimator only its logarithmization solves this issue. Unfortunately, since the logarithm of zero is not defined as a logarithmic function, the domain is restricted for positive values only, and all of the zero trade flow observations have to be dropped. The observed dataset consists of 127750 observations out of which 13023 are/were zero trade value observations, which gives a 9,8% share of zero observations. In accordance with Francois & Manchin (2013), who have also used the UN Comtrade database, we presume that if a country has reported any exports in a given year, these zero observations represent true zeros.[11] Thus, in the case of estimation using normal OLS, almost 10% of the observations, which are most likely representing true zeros, would be dropped and their information would be lost. For this reason, the OLS cannot be an appropriate estimator as it surges of the selection bias. Thus we have to choose the PPML estimator.

### The Poisson Pseudo-Maximum Likelihood Estimator

The conditions and properties of the Poisson Pseudo-Maximum Likelihood estimator are fortunately much more favorable. First of all, in comparison with the OLS estimator, PPML does not suffer from zero observations. It can easily incorporate them since the dependent variable is not in a logarithmic form as in case of the OLS. Moreover, the estimator's performance under the presence of zero observations was proven by Santos Silva & Tenreyro (2011), who have

[11] In cases where there were no reported exports from any country in a year, these zero observations have been dropped.

shown that this estimator performs “excellently” even under a higher share of zeros. To cover for the potential heteroskedasticity, Santos Silva & Tenreyro (2006) have shown that if PPML contains a correct set of explanatory variables, this estimator provides heteroskedasticity robust and consistent estimates. Moreover, PPML is consistent under over-dispersion, which is present in the observed dataset, as it does not make any dispersion-related assumptions. Even though the distribution in observed dataset seems to be more a Negative Binomial than any other, it does not affect the estimator nevertheless, since PPML does not make any assumptions about the statistical distribution of the underlying dataset. This property arises as it is a pseudo-maximum likelihood and not a maximum likelihood estimator (Santos Silva & Tenreyro, 2006).

To test the specification of the PPML estimator, we have performed the Ramsey RESET in a specification adjusted for PPML proposed by Santos Silva & Tenreyro (2006). Test’s result a was failure to reject the null hypothesis that the fitted values are equal to zero. This fulfills the correct specification condition for consistency of the estimator.

Further PPML estimator was estimated under a correction for the possible correlation between the error term and the country pairs. A chance of this correlation is, according to Shepherd (2012), highly presumable. This source also cites the research of Moulton (1990), who has shown that failure to account for clustering results in a highly underestimated standard error of the estimates. Here the presented model has accounted for the country pair clusters through its unique mutual distance that is also equal in exports from country $j$ to country $i$ as well as for exports from country $i$ to $j$.

# Chapter 4

# Estimation Results

## 4.1 Aggregated versus Disaggregated Model

This chapter presents the results of the regressions applied on aggregated and disaggregated sections. The dependent variable is trade value in millions of USD. The discussion of the results is provided in chapter 5.

### 4.1.1 Aggregated Model Results

In order to prove previous findings of Siliverstovs & Schumacher (2008) that the globalization puzzle is hidden mainly in the disaggregated trade, we have compared the aggregated and disaggregated results. As the aggregated model has to cover for many often contradictory underlying trends, the expectations of its results were rather skeptical. This was proven by a very low $R^2$ of average value of 32%.[1] The observed incapability to capture an increase in neither globalization nor an insignificance of all inter-bloc dummies can be surprising for this model. As the model surged on low explanatory value, the summary and the graph of distance coefficient evolution is not stated here, yet it can be found in the Appendix A.

### 4.1.2 Re-aggregated Model Results

Prehn & Brummer (2011) suggest that once one wants to observe aggregated trade flows, he should use the disaggregated data and re-aggregate them in the model. In order to test that, we performed this kind of analysis. The results highly outperform the ones of the aggregated model which was used above as

[1] Averaging $R^2$'s of single year estimation.

the average $R^2$ of the model reaches value of 75%. The summary of the results can be found below.

Table 4.1: Re-aggregated Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.885*** | 0.870*** | 0.850*** | 0.827*** | 0.856*** | 0.846*** |
| | (0.0473) | (0.0337) | (0.0353) | (0.0386) | (0.0427) | (0.0434) |
| ln_expGDPinmil | 0.907*** | 0.875*** | 0.870*** | 0.864*** | 0.855*** | 0.833*** |
| | (0.0516) | (0.0392) | (0.0383) | (0.0416) | (0.0442) | (0.0422) |
| MR_ln_distw | -0.902*** | -1.098*** | -0.900*** | -0.773*** | -0.967*** | -0.893*** |
| | (0.166) | (0.132) | (0.128) | (0.156) | (0.166) | (0.178) |
| MR_west_to_east | 1.083 | -2.063* | 0.969 | 0.0755 | 1.536 | 1.284 |
| | (2.386) | (1.077) | (1.097) | (1.121) | (1.154) | (1.096) |
| MR_east_to_west | -2.779 | 1.096 | -0.118 | 0.907 | -0.329 | -0.318 |
| | (2.321) | (1.114) | (1.074) | (1.236) | (1.299) | (1.243) |
| Observations | 6,500 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 |
| R-squared | 0.831 | 0.832 | 0.751 | 0.694 | 0.690 | 0.682 |

*Source:* Authors' Computation

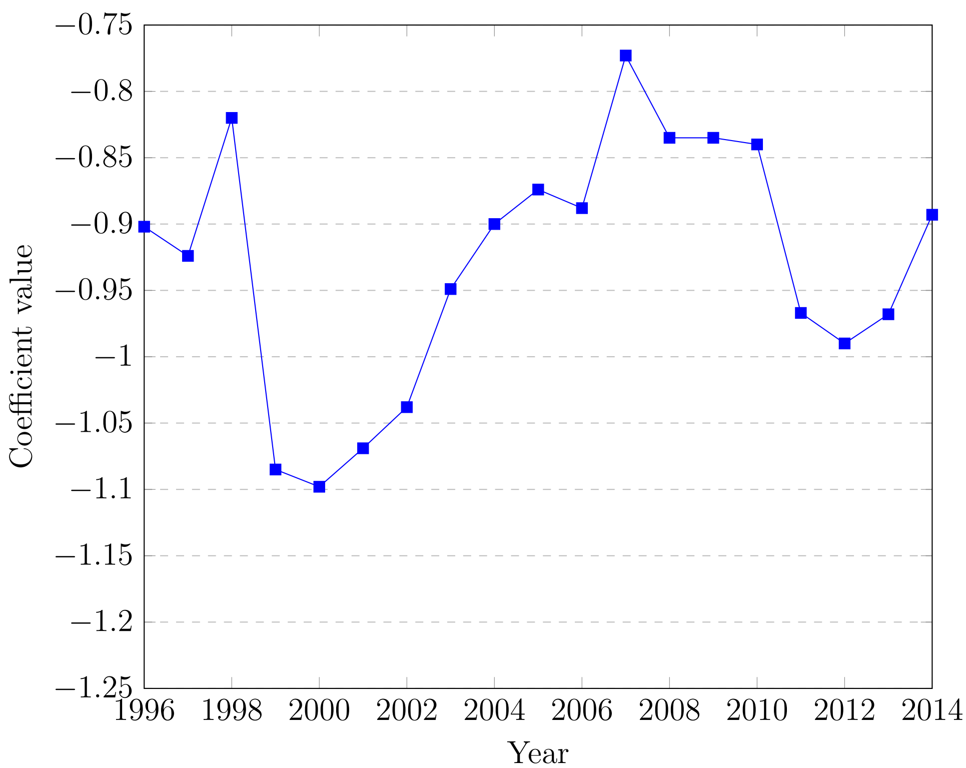


Figure 4.1: Evolution of distance coefficient for re-aggregated data

The dummy *east_to_west* was statistically insignificant in every one of the observed years. The *west_to_east* dummy was statistically significant on $\alpha = 5\%$ only in one year. Due to this fact we were unable to observe inter-bloc convergence in this model. This is also why are not presenting a table of dummies here. Importer's and exporter's GDPs have been statistically significant in every year. Also *comcol*, a dummy variable for pairs with common colonizer post 1945, has shown positive statistically significant results every year. However, since out of the 351 country pairs in the dataset there are only 4 pairs with this relationship — Cyprus with Malta and the triangle Lithuania, Latvia and Estonia — this result should be taken with slight caution as it may express other unobserved attributes that have these 4 pairs in common besides the colonial history that may affect the estimation of this variable. On the other hand the estimation showed, according with our assumptions, positive effect of historical relations on trade.

### 4.1.3 Disaggregated Model Results

The dataset was divided into 10 parts according the SITC sections of trade. The process of disaggregation has shown substantial heterogeneity between single trade sections. It has also shown diverse inter-bloc evolution and often its convergence. Last but not least, an increase in globalization was found in this dataset, as for 9 of the sections the distance coefficient showed a decreasing trend. Disaggregation in comparison with aggregated trade brought a substantial improvement of the coefficient of determination $R^2$ as well. Its average value has risen to 70%. The highest value of 83% had Section 7 (Machinery and transport equipment) followed by Section 0 (Food and live animals) and Section 6 (Manufactured goods classified chiefly by material) with $R^2$ around 80%. The lowest fit of 51% had Section 4 (Animal and vegetable oils, fats and waxes). The summary of results for single SITC sections will be presented below, the complete results can be found in appendix A. The discussion of the results is provided in the following chapter 5.

### 4.1.4 Section 0 – Food and live animals

Section 0 is well suitable for the gravity model. The average $R^2$ value is 80% — the second highest among all sections. The share of zero observations is 5% as there are 627 zero observations in the data. There seems to be a slight decreasing trend of the distance coefficient, and the inter-bloc dummies seem to converge. Unfortunately these dummies are statistically significant only in 5 years. All the supporting explanatory variables were in line with the presumed sign except for two. The first variable was trade foundation, which suggests that the more the countries differ in terms of trade and monetary freedom, the more they should trade (although one would presume the complete opposite). The second variable was importer's landlockness, whose estimation suggests a decrease in trade, although as we have discussed above this variable seems to express a central geographical orientation of the country on the continent. The continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks. For every section, a graph of distance coefficient and inter-bloc dummies coefficients is attached. The square dot on the graph indicates that the coefficient was statistically significant in a given year. This notation is used in throughout the chapter.

Table 4.2: Section 0 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.892*** | 0.877*** | 0.861*** | 0.809*** | 0.782*** | 0.781*** |
| | (0.0676) | (0.0553) | (0.0509) | (0.0486) | (0.0538) | (0.0563) |
| ln_expGDPinmil | 0.668*** | 0.695*** | 0.723*** | 0.702*** | 0.690*** | 0.686*** |
| | (0.0665) | (0.0508) | (0.0433) | (0.0438) | (0.0412) | (0.0424) |
| MR_ln_distw | -1.106*** | -1.300*** | -1.060*** | -1.047*** | -1.115*** | -1.060*** |
| | (0.196) | (0.155) | (0.121) | (0.136) | (0.154) | (0.161) |
| MR_west_to_east | -3.602 | -9.382*** | -1.856 | -2.113 | -3.114* | -1.616 |
| | (4.177) | (2.731) | (2.649) | (2.082) | (1.809) | (2.007) |
| MR_east_to_west | 2.368 | 7.466*** | 0.468 | 1.756 | 3.290* | 1.887 |
| | (4.187) | (2.694) | (2.550) | (2.035) | (1.821) | (1.925) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.779 | 0.835 | 0.822 | 0.786 | 0.757 | 0.729 |

*Source:* Authors' Computation

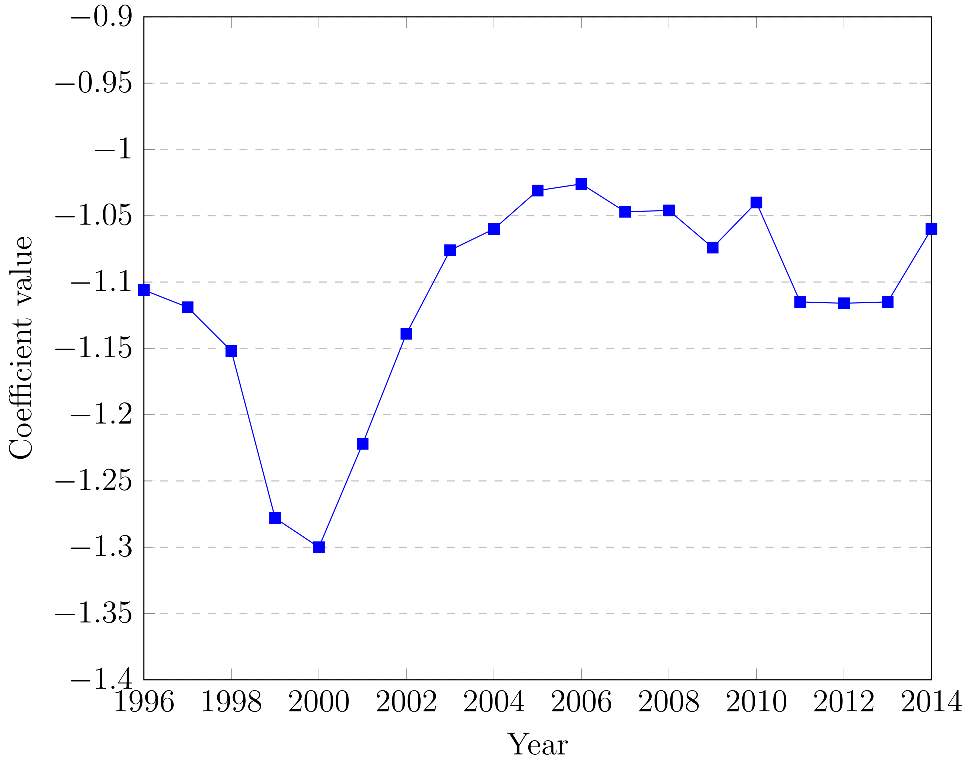


Figure 4.2: SITC 0 - Evolution of distance coefficient

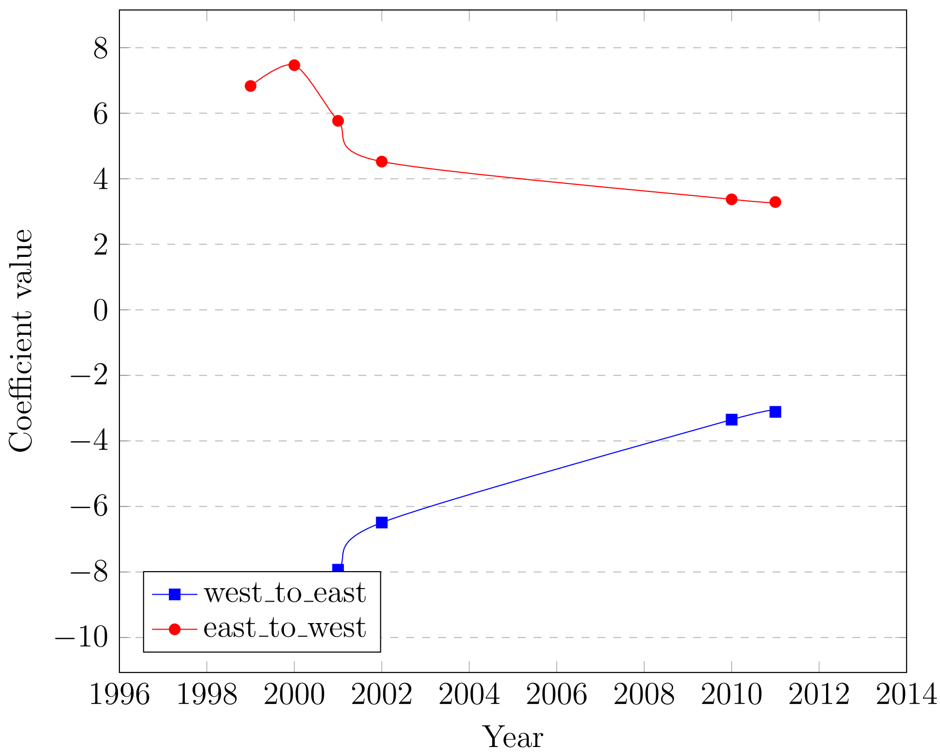


Figure 4.3: SITC 0 - Evolution of inter-bloc dummies

### 4.1.5 Section 1 - Beverages and tobacco

Section 1 seems to perform mediocre under the gravity model. The average $R^2$ value of 69% is the 6th highest of the observed sections. The share of zero observations is 10% as there are 1350 zero observations in the data. Interestingly the usually positive explanatory variable of contiguity suggests a negative effect between neighboring countries . This variable, however, is significant only in three of all the years. Surprisingly also here the monetary and trade freedom variable suggests that the bigger the difference between the countries is, the more they should trade. Also the social business foundation variable suggests that the higher the difference between the countries is, the more should they trade. The continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks.

Table 4.3: Section 1 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.857*** | 0.766*** | 0.827*** | 0.793*** | 0.770*** | 0.726*** |
| | (0.0664) | (0.0653) | (0.0529) | (0.0535) | (0.0537) | (0.0488) |
| ln_expGDPinmil | 0.797*** | 0.865*** | 0.934*** | 0.909*** | 0.882*** | 0.847*** |
| | (0.0689) | (0.0729) | (0.0558) | (0.0593) | (0.0515) | (0.0420) |
| MR_ln_distw | -1.253*** | -1.570*** | -1.305*** | -1.346*** | -1.218*** | -1.151*** |
| | (0.301) | (0.247) | (0.189) | (0.152) | (0.180) | (0.164) |
| MR_west_to_east | -4.904 | -8.754*** | -11.02*** | -6.881** | 2.789 | 7.474* |
| | (4.563) | (3.345) | (2.777) | (3.085) | (3.249) | (3.982) |
| MR_east_to_west | 3.226 | 6.461** | 7.585*** | 4.853* | -3.289 | -7.539** |
| | (4.803) | (3.276) | (2.691) | (2.906) | (3.052) | (3.671) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.640 | 0.656 | 0.704 | 0.718 | 0.709 | 0.722 |

*Source:* Authors' Computation

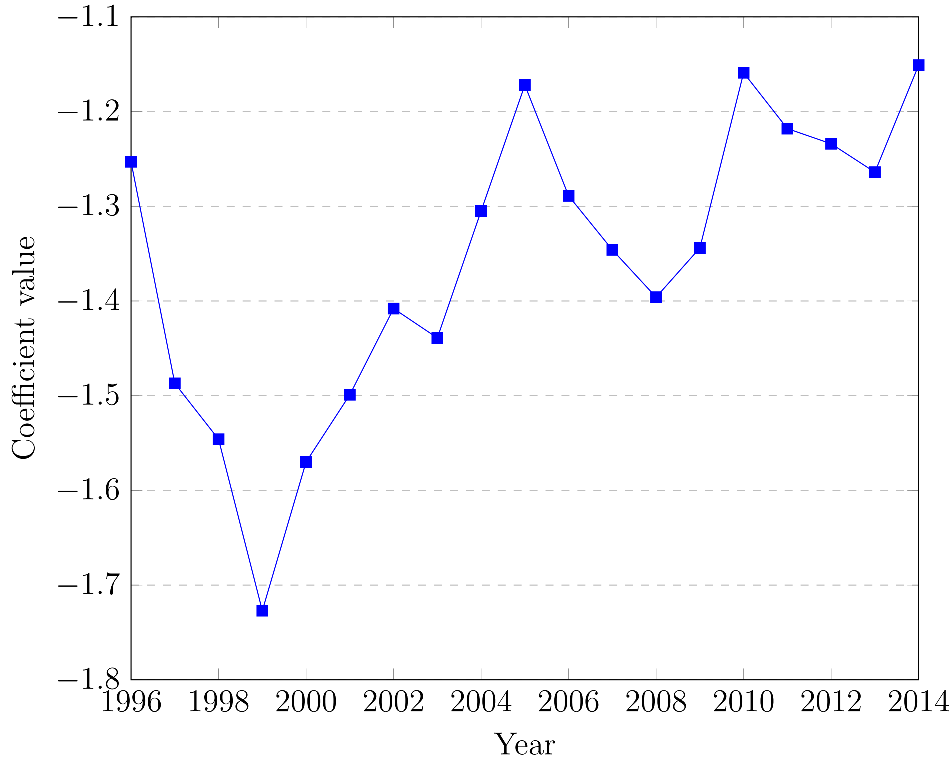


Figure 4.4: SITC 1 - Evolution of distance coefficient

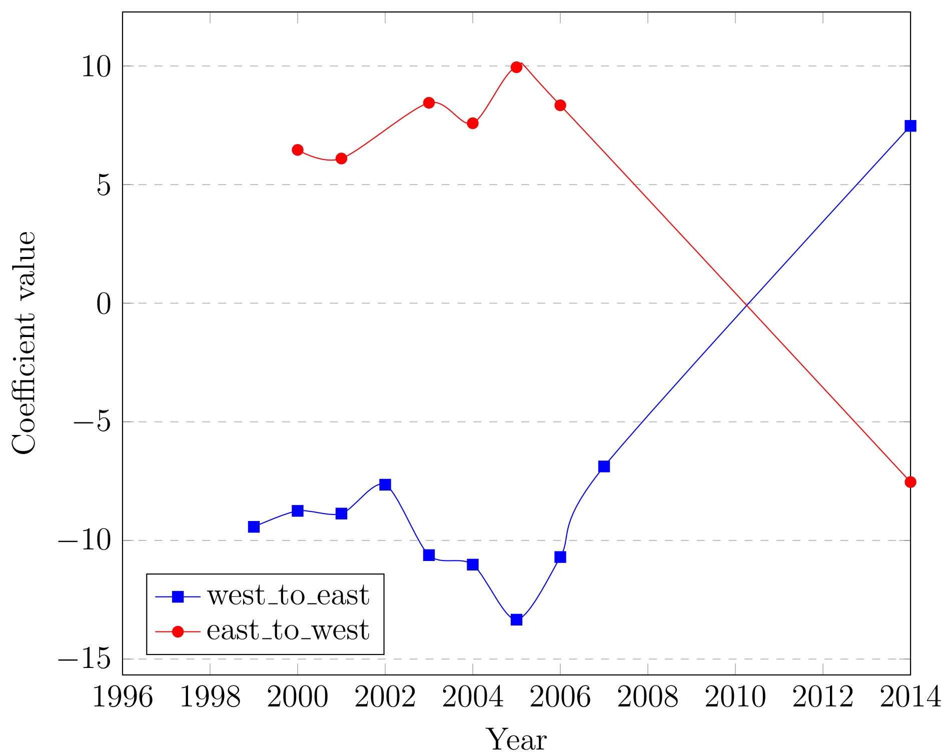


Figure 4.5: SITC 1 - Evolution of inter-bloc dummies

### 4.1.6 Section 2 - Crude materials, inedible, except fuels

Section 2 performs slightly below average. The average $R^2$ value of 67% is the 4th lowest of observed sections. The share of zero observations is 7% as there are 890 zero observations in the data. The distance coefficient seems to be very sensitive to the recessions as can be seen in the time period 1998–2001 and 2007–2011. It is hard to make any conclusions about the inter-bloc dummies as they lack significance in majority of the observations.[2] Surprisingly, also here the monetary and trade freedom variable suggests that the bigger the difference between the countries is, the more they should trade. The continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks.

Table 4.4: Section 2 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.900*** | 0.850*** | 0.811*** | 0.748*** | 0.744*** | 0.752*** |
| | (0.0652) | (0.0543) | (0.0566) | (0.0510) | (0.0567) | (0.0644) |
| ln_expGDPinmil | 0.440*** | 0.509*** | 0.559*** | 0.587*** | 0.609*** | 0.587*** |
| | (0.0726) | (0.0531) | (0.0422) | (0.0469) | (0.0423) | (0.0436) |
| MR_ln_distw | -0.754*** | -0.990*** | -0.815*** | -0.606*** | -0.818*** | -0.690*** |
| | (0.244) | (0.178) | (0.160) | (0.185) | (0.195) | (0.221) |
| MR_west_to_east | -2.351 | 0.591 | 4.019 | 4.673* | 3.683 | 1.952 |
| | (4.198) | (2.874) | (3.086) | (2.537) | (2.629) | (2.642) |
| MR_east_to_west | 3.487 | 0.354 | -3.896 | -3.980 | -2.702 | -0.988 |
| | (4.268) | (2.899) | (3.000) | (2.556) | (2.781) | (2.712) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.661 | 0.701 | 0.670 | 0.655 | 0.659 | 0.604 |

*Source:* Authors' Computation

[2] In the graph east_to_west to have $\alpha = 10\%$ statistical significance level.

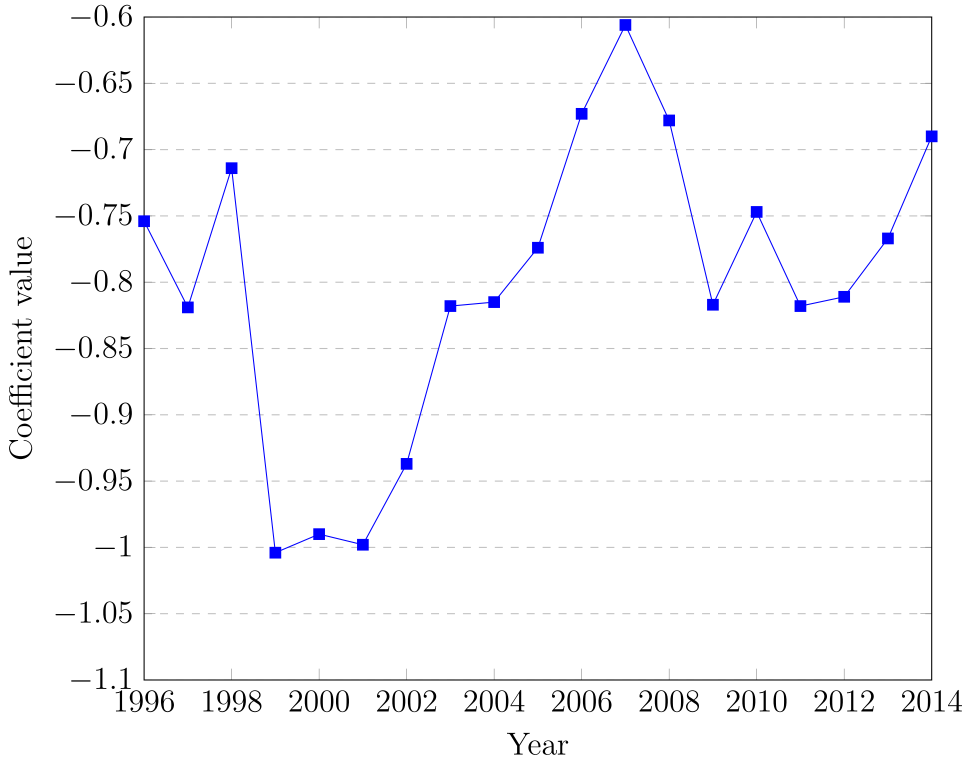


Figure 4.6: SITC 2 - Evolution of distance coefficient

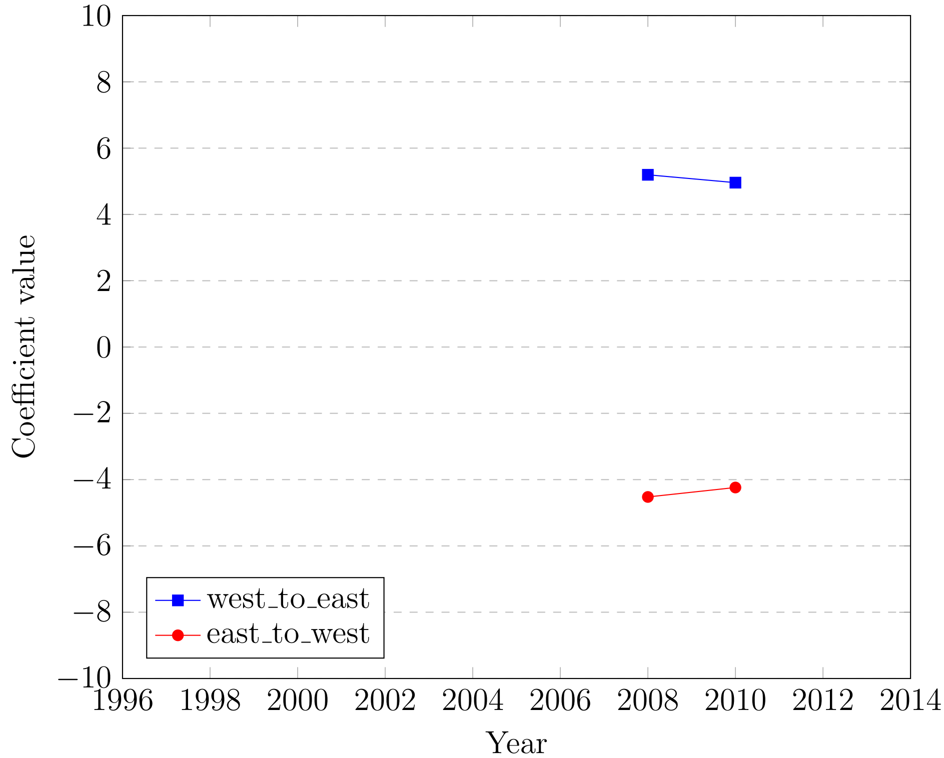


Figure 4.7: SITC 2 - Evolution of inter-bloc dummies

### 4.1.7 Section 3 - Mineral fuels, lubricants and related materials

Section 3 seems not to suit the gravity model well. The average $R^2$ value of 57% is the 2nd lowest of the observed sections. The share of zero observations is 16% as there are 2050 zero observations in the data. There seem to be a decrease of the distance coefficient although the coefficient was highly affected in the 1998–2000 period. Traces of convergence between the blocs can be seen in the inter-bloc dummies. Surprisingly the dummy variable for intra-EU trade has a negative coefficient estimates. As in the previous section continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks.

Table 4.5: Section 3 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.948*** | 0.961*** | 0.796*** | 0.775*** | 0.772*** | 0.823*** |
| | (0.188) | (0.142) | (0.108) | (0.0937) | (0.103) | (0.148) |
| ln_expGDPinmil | 0.729*** | 0.905*** | 0.786*** | 0.853*** | 0.723*** | 0.699*** |
| | (0.139) | (0.104) | (0.0867) | (0.0895) | (0.0814) | (0.0767) |
| MR_ln_distw | -2.148*** | -2.651*** | -2.162*** | -1.919*** | -2.053*** | -1.864*** |
| | (0.324) | (0.240) | (0.221) | (0.225) | (0.261) | (0.290) |
| MR_west_to_east | 2.431 | 3.681 | 18.01*** | 5.082 | 7.204* | 2.033 |
| | (10.31) | (6.219) | (4.890) | (4.249) | (4.112) | (4.899) |
| MR_east_to_west | -8.031 | -9.096 | -18.17*** | -4.506 | -6.842 | -0.955 |
| | (10.58) | (6.072) | (4.881) | (4.423) | (4.340) | (4.998) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.573 | 0.550 | 0.558 | 0.634 | 0.579 | 0.520 |

*Source:* Authors' Computation

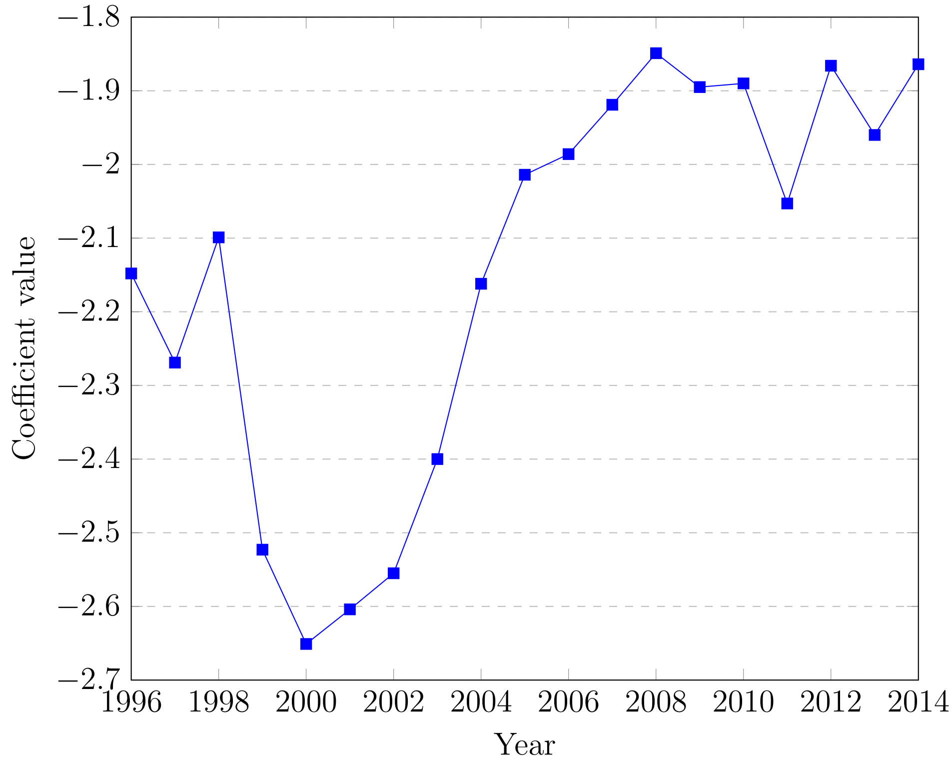


Figure 4.8: SITC 3 - Evolution of distance coefficient

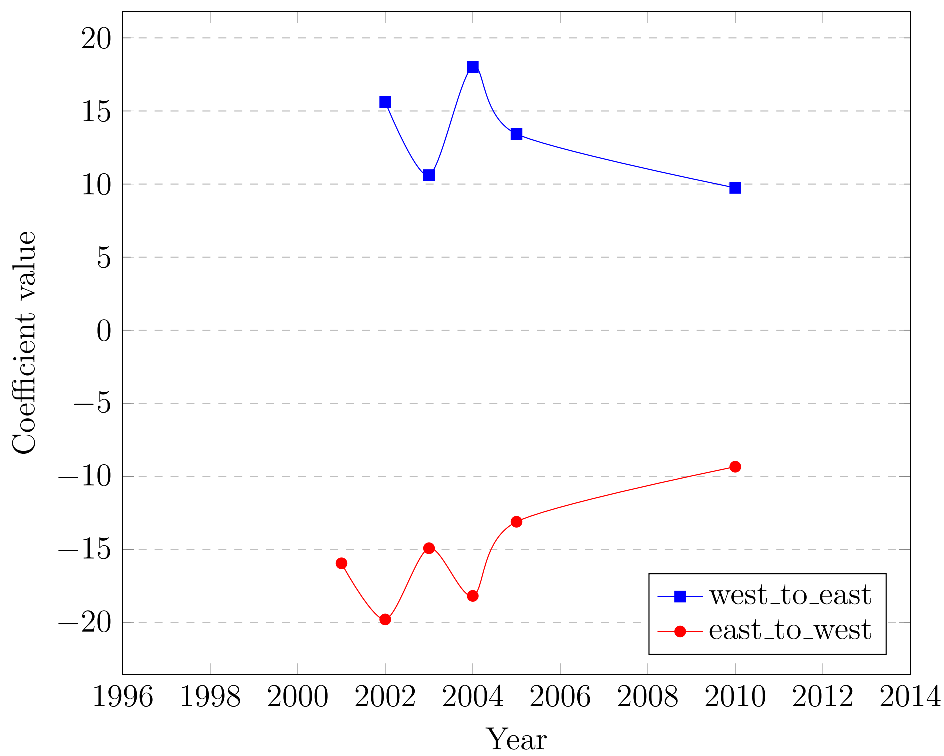


Figure 4.9: SITC 3 - Evolution of inter-bloc dummies

### 4.1.8 Section 4 - Animal and vegetable oils, fats and waxes

Section 4 seems to be unsuitable for the gravity model application. The average $R^2$ value of 51% is the lowest of the observed sections, therefore about a half of the variance of the data remains unexplained. The share of zero observations is 28% as there are 3743 zero observations in the data. The distance coefficient is very sensitive on the recessions as can be seen in the graph below. The blocs seem to converge over time. Further, the institutional variable of trade and monetary freedom does not fulfill our assumptions as it has a positive value. The continuous development of estimated coefficients and a stability of $R^2$ does not point on any structural breaks.

Table 4.6: Section 5 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.922*** | 0.918*** | 0.969*** | 0.963*** | 0.786*** | 0.706*** |
| | (0.145) | (0.0976) | (0.130) | (0.112) | (0.106) | (0.0938) |
| ln_expGDPinmil | 0.676*** | 0.762*** | 0.853*** | 0.738*** | 0.737*** | 0.668*** |
| | (0.116) | (0.0965) | (0.0812) | (0.0855) | (0.0701) | (0.0609) |
| MR_ln_distw | -1.817*** | -1.990*** | -1.718*** | -1.686*** | -1.870*** | -1.532*** |
| | (0.326) | (0.195) | (0.196) | (0.227) | (0.258) | (0.274) |
| MR_west_to_east | -16.70** | -36.75*** | -32.86*** | -8.139 | -11.54*** | -3.127 |
| | (7.723) | (5.554) | (5.606) | (5.631) | (3.895) | (4.396) |
| MR_east_to_west | 15.96** | 33.01*** | 29.55*** | 8.559 | 11.24*** | 2.869 |
| | (7.952) | (5.309) | (4.922) | (5.387) | (3.780) | (4.418) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.506 | 0.585 | 0.515 | 0.483 | 0.508 | 0.386 |

*Source:* Authors' Computation

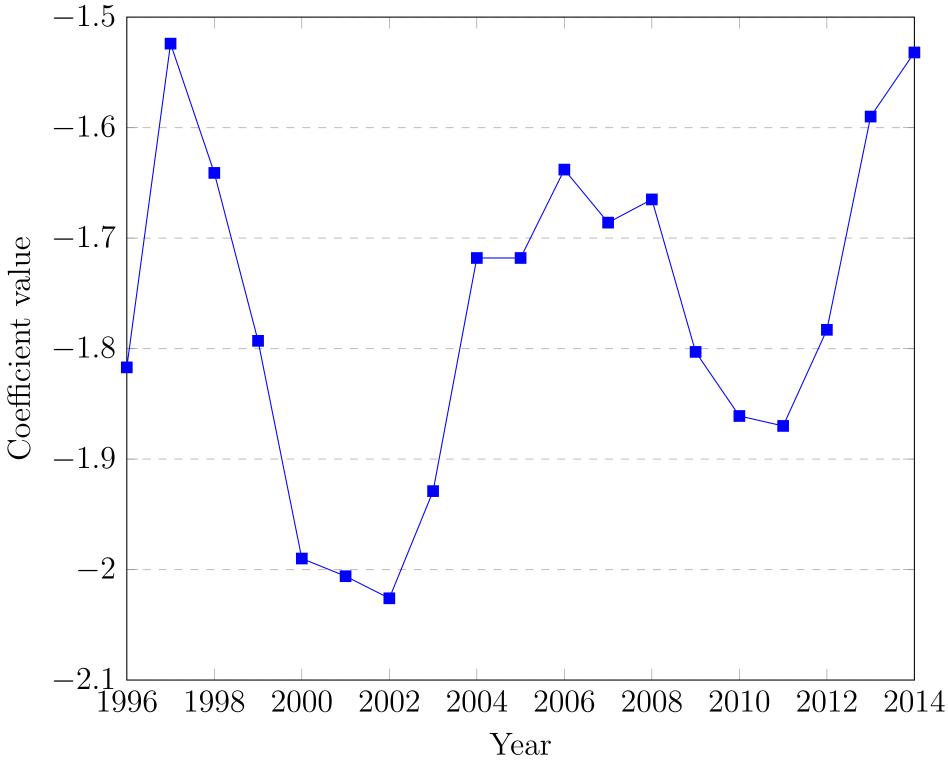


Figure 4.10: SITC 4 - Evolution of distance coefficient

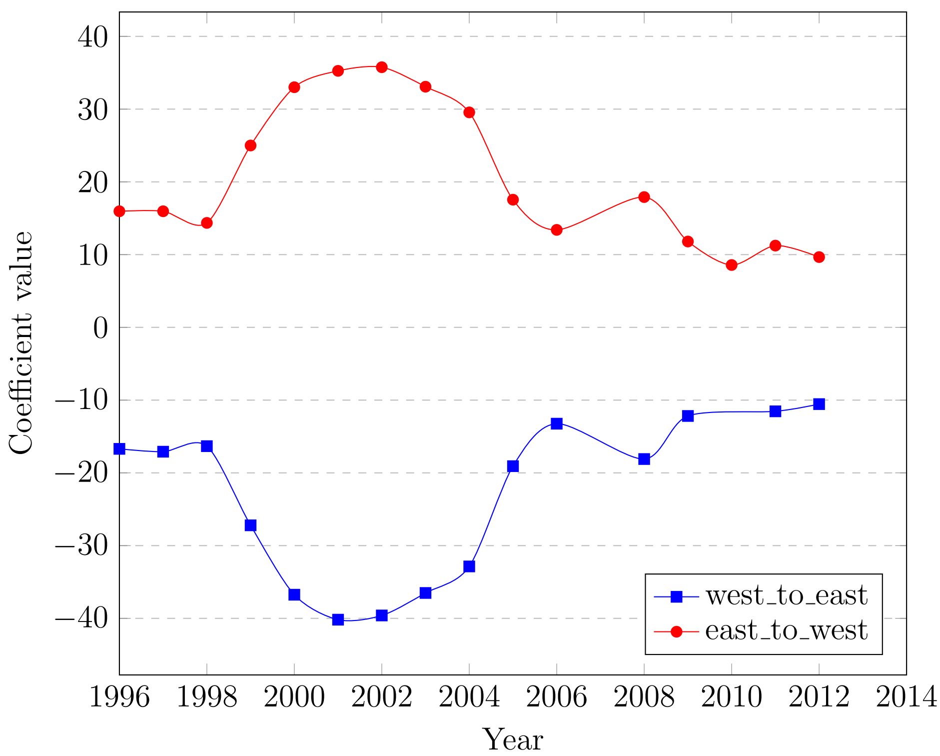


Figure 4.11: SITC 4 - Evolution of inter-bloc dummies

### 4.1.9 Section 5 - Chemicals and related products, n.e.s.

Section 5 has an average performance under the gravity model. The average $R^2$ value is 72% — the fifth highest among all sections. The share of zero observations is only 2.4% as there are 319 zero observations in the data. The distance coefficient seems to be highly affected by the Great Recession so its decrease cannot be confirmed. A slight gradual inter-bloc convergence is observed. Between 2000 and 2001, there is a high drop of the $R^2$. Apparently a new condition appeared on the market and none of current explanatory variables covers for it. We have tried to add supplementary explanatory variables but none of them have covered for this abnormality.

Table 4.7: Section 5 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.812*** | 0.832*** | 0.842*** | 0.830*** | 0.864*** | 0.857*** |
| | (0.0424) | (0.0515) | (0.0731) | (0.0665) | (0.0577) | (0.0571) |
| ln_expGDPinmil | 0.931*** | 0.753*** | 0.757*** | 0.751*** | 0.745*** | 0.762*** |
| | (0.0673) | (0.0684) | (0.0797) | (0.0713) | (0.0630) | (0.0551) |
| MR_ln_distw | -0.987*** | -1.066*** | -0.864*** | -0.669** | -0.992*** | -0.983*** |
| | (0.179) | (0.157) | (0.247) | (0.275) | (0.214) | (0.219) |
| MR_west_to_east | -2.369 | -16.60*** | -17.83*** | -15.76*** | -14.04*** | -12.46*** |
| | (3.955) | (2.359) | (2.161) | (1.704) | (1.601) | (1.696) |
| MR_east_to_west | -0.269 | 15.40*** | 15.90*** | 14.85*** | 13.61*** | 11.82*** |
| | (3.874) | (2.373) | (2.102) | (1.698) | (1.538) | (1.664) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.856 | 0.825 | 0.652 | 0.639 | 0.677 | 0.690 |

*Source:* Authors' Computation

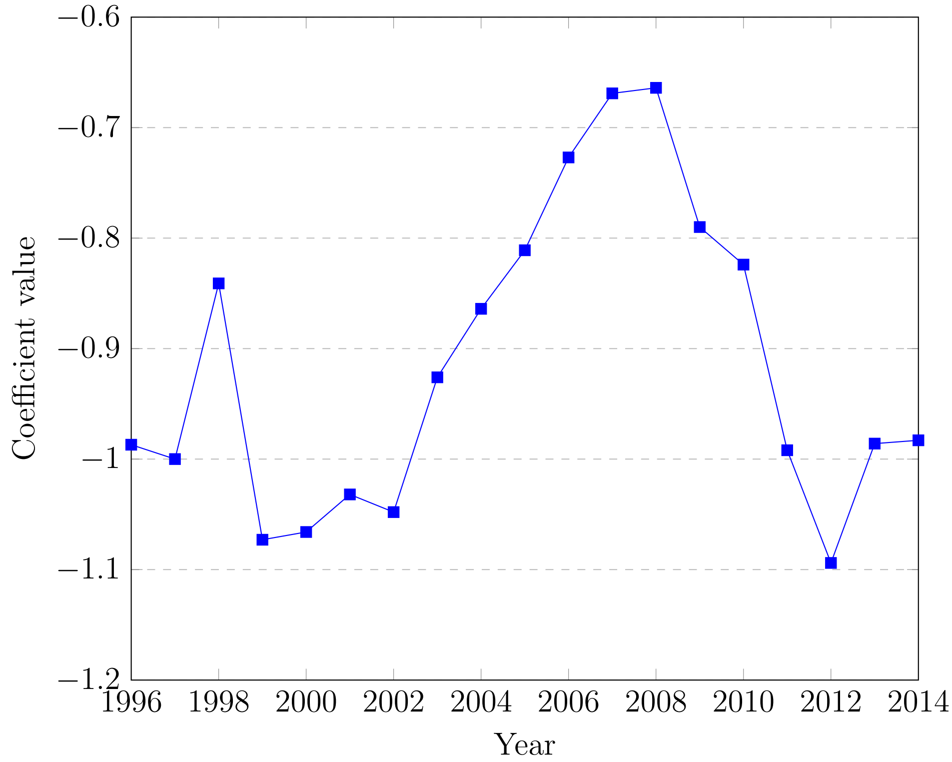


Figure 4.12: SITC 5 - Evolution of distance coefficient

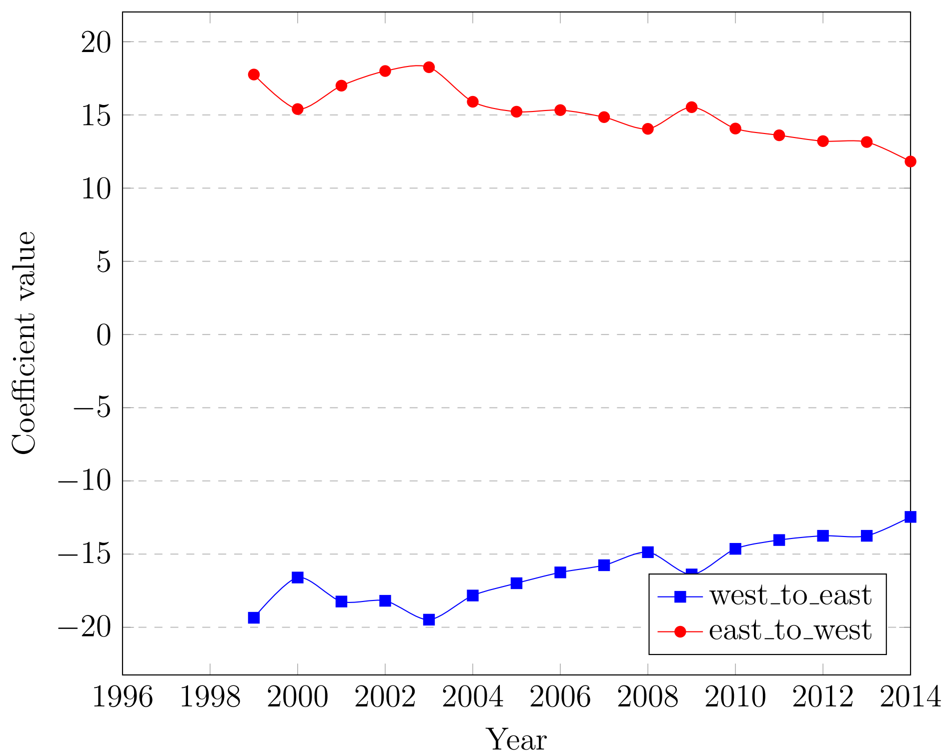


Figure 4.13: SITC 5 - Evolution of inter-bloc dummies

### 4.1.10 Section 6 - Manufactured goods classified chiefly by material

Section 6 suits the gravity model very well. The average $R^2$ value is 80%, the third highest among all sections. The share of zero observations is only 3% as there are 420 zero observations in the data. There seems to be a very slight decreasing trend of the distance coefficient, although this trend was highly affected in 1998–2000. The inter-bloc dummies appear to converge over time. All of the supporting explanatory variables were in line with the presumed sign. The continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks.

Table 4.8: Section 6 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.860*** | 0.861*** | 0.801*** | 0.826*** | 0.866*** | 0.844*** |
| | (0.0650) | (0.0475) | (0.0443) | (0.0504) | (0.0517) | (0.0503) |
| ln_expGDPinmil | 0.864*** | 0.811*** | 0.770*** | 0.776*** | 0.790*** | 0.775*** |
| | (0.0641) | (0.0473) | (0.0448) | (0.0482) | (0.0496) | (0.0478) |
| MR_ln_distw | -0.686*** | -1.018*** | -0.752*** | -0.615*** | -0.753*** | -0.608*** |
| | (0.187) | (0.184) | (0.167) | (0.177) | (0.172) | (0.193) |
| MR_west_to_east | -0.359 | -5.496*** | -2.811** | -3.756*** | -2.243** | -1.786 |
| | (2.268) | (1.620) | (1.422) | (1.299) | (1.111) | (1.105) |
| MR_east_to_west | -1.388 | 4.201*** | 3.893*** | 4.632*** | 3.317*** | 2.672** |
| | (2.215) | (1.580) | (1.444) | (1.308) | (1.198) | (1.144) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.826 | 0.826 | 0.788 | 0.743 | 0.764 | 0.744 |

*Source:* Authors' Computation

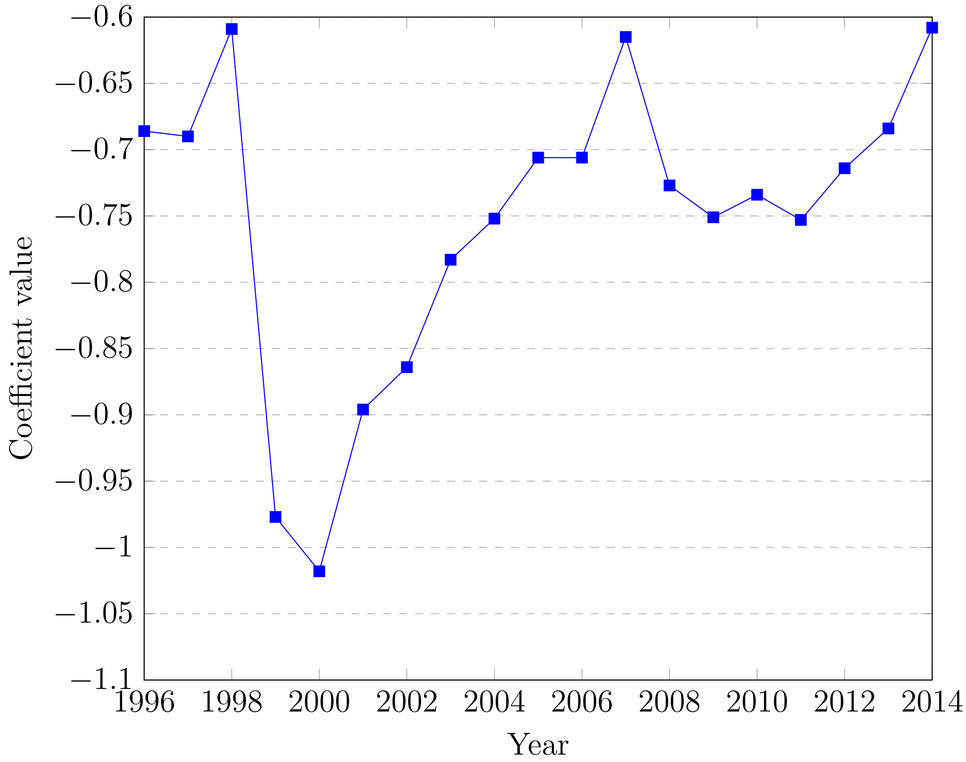


Figure 4.14: SITC 6 - Evolution of distance coefficient

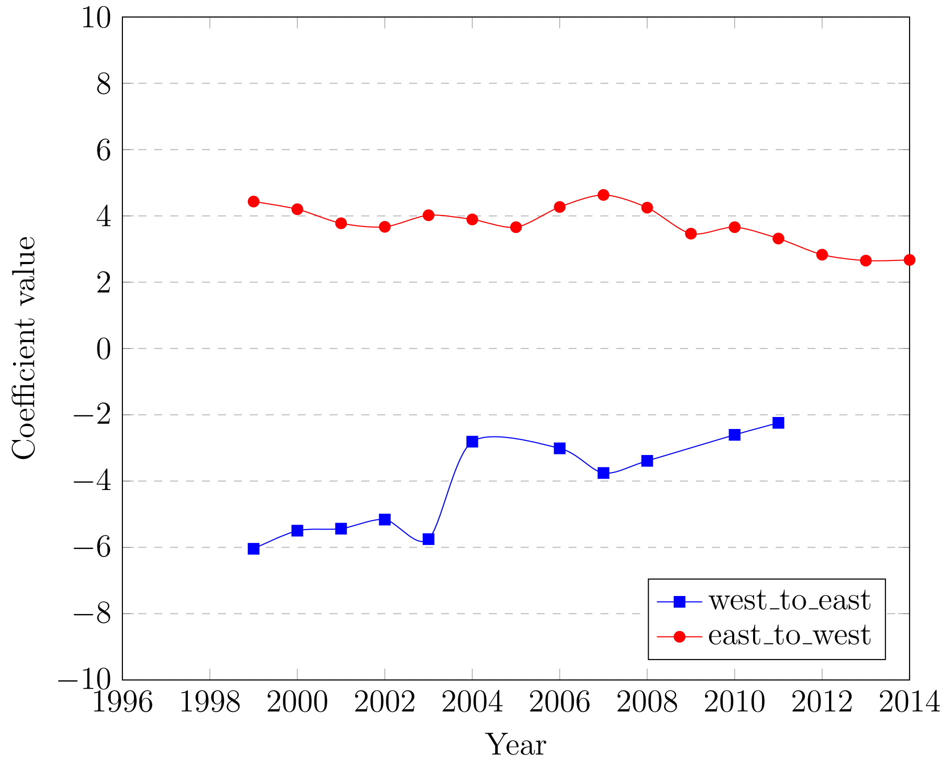


Figure 4.15: SITC 6 - Evolution of inter-bloc dummies

### 4.1.11 Section 7 - Machinery and transport equipment

Section 7 seems to work best with the gravity model. The average $R^2$ value, 83%, is the highest among all sections. The share of zero observations is only 3% as there are 325 zero observations in the data. There seems to be a slight decreasing trend of the distance coefficient and a slight inter-bloc dummies divergence. All of the supporting explanatory variables were in line with the presumed sign except the intra-EU trade. The landlock dummies have a positive sign, a slight abnormality which is consistent with our previous assumptions about its meaning in this specific dataset. The continuous development of estimated coefficients and a stability of $R^2$ does not suggest any structural breaks.

Table 4.9: Section 7 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.914*** | 0.884*** | 0.900*** | 0.861*** | 0.926*** | 0.911*** |
| | (0.0433) | (0.0363) | (0.0364) | (0.0414) | (0.0508) | (0.0482) |
| ln_expGDPinmil | 1.069*** | 0.994*** | 1.030*** | 1.008*** | 1.045*** | 1.011*** |
| | (0.0557) | (0.0474) | (0.0454) | (0.0514) | (0.0612) | (0.0553) |
| MR_ln_distw | -0.849*** | -0.942*** | -0.730*** | -0.559*** | -0.662*** | -0.620*** |
| | (0.169) | (0.171) | (0.153) | (0.206) | (0.232) | (0.205) |
| MR_west_to_east | 0.667 | 0.763 | 4.125*** | 3.699*** | 6.340*** | 5.375*** |
| | (2.576) | (1.453) | (1.241) | (1.235) | (1.293) | (1.182) |
| MR_east_to_west | -1.767 | -0.711 | -2.226* | -2.126 | -4.473*** | -4.014*** |
| | (2.401) | (1.488) | (1.151) | (1.358) | (1.431) | (1.370) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.908 | 0.884 | 0.824 | 0.758 | 0.778 | 0.794 |

*Source:* Authors' Computation

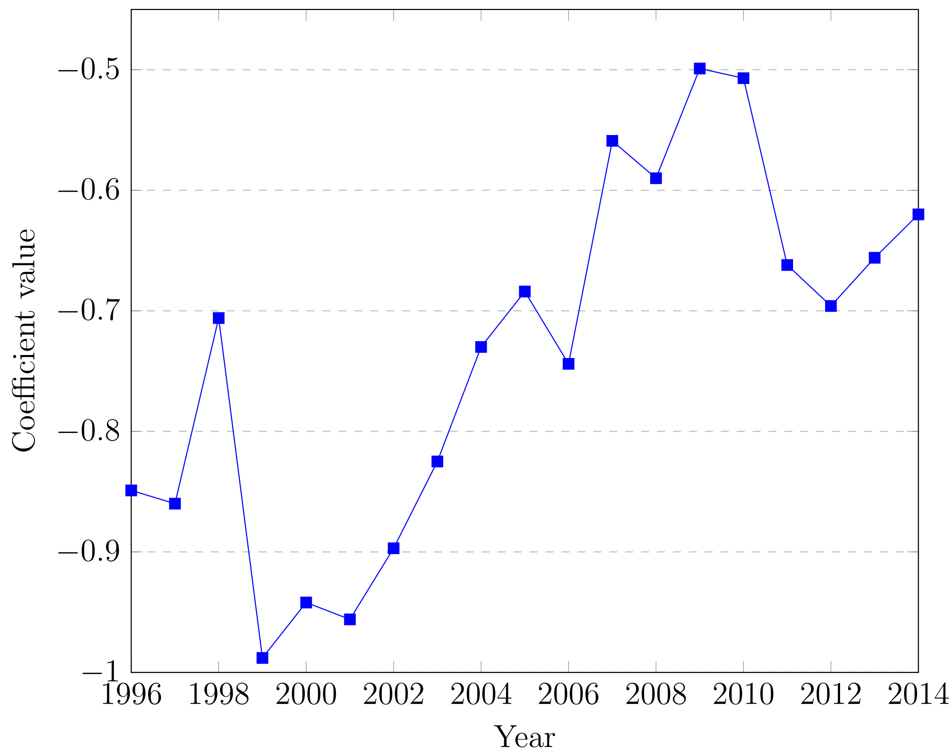


Figure 4.16: SITC 7 - Evolution of distance coefficient

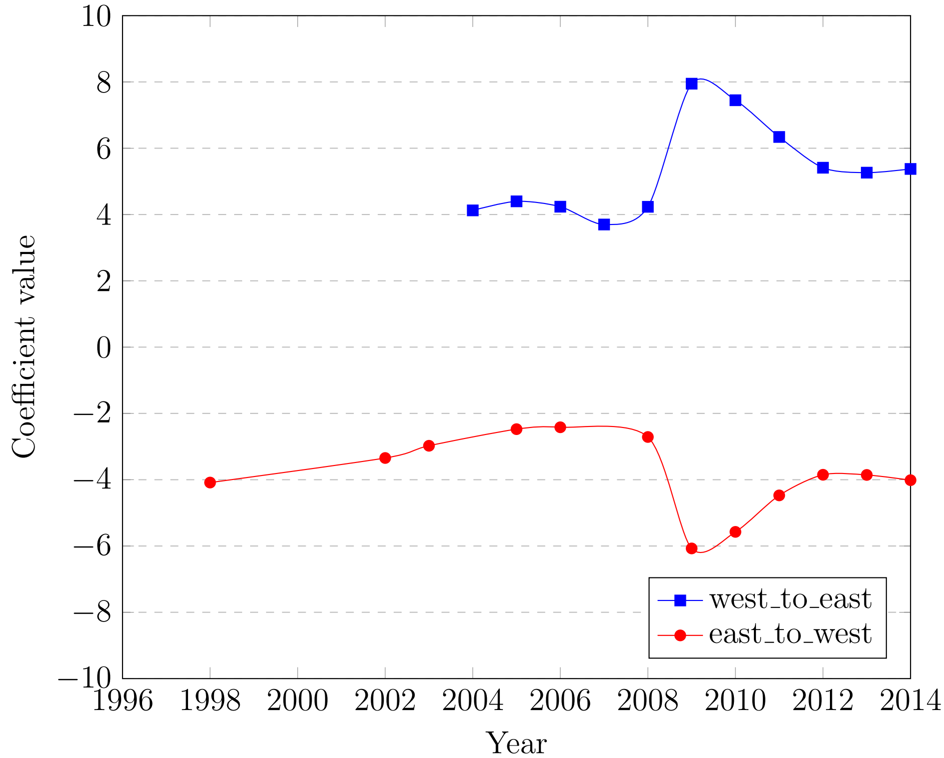


Figure 4.17: SITC 7 - Evolution of inter-bloc dummies

### 4.1.12 Section 8 - Miscellaneous manufactured articles

Section 8 is well suited to the gravity model. The average $R^2$ value is 80% — the second highest among all sections. The share of zero observations is the lowest of all the sections of trade. It is only 2% share as there are 627 zero observations in the data. Over the observed period the distance coefficient seems to be stable. The inter-bloc dummies seem to have a stable value as well. The supporting explanatory variables were in line with the presumed sign. The exporter's landlockness is estimated to positively affect the amount of trade. No structural break can be suggested based on the continuous development of estimated coefficients and the stability of $R^2$.

Table 4.10: Section 8 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.941*** | 0.866*** | 0.857*** | 0.802*** | 0.856*** | 0.858*** |
| | (0.0830) | (0.0491) | (0.0427) | (0.0451) | (0.0462) | (0.0463) |
| ln_expGDPinmil | 0.830*** | 0.804*** | 0.836*** | 0.848*** | 0.848*** | 0.832*** |
| | (0.0601) | (0.0463) | (0.0433) | (0.0447) | (0.0471) | (0.0468) |
| MR_ln_distw | -0.868*** | -1.053*** | -0.934*** | -0.799*** | -0.879*** | -0.845*** |
| | (0.184) | (0.152) | (0.132) | (0.154) | (0.146) | (0.170) |
| MR_west_to_east | 6.958** | 4.994*** | 8.444*** | 7.391*** | 6.710*** | 6.670*** |
| | (3.008) | (1.694) | (1.777) | (1.685) | (1.448) | (1.421) |
| MR_east_to_west | -7.862*** | -5.328*** | -7.302*** | -6.228*** | -5.168*** | -5.273*** |
| | (2.943) | (1.750) | (1.828) | (1.670) | (1.521) | (1.481) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.715 | 0.798 | 0.807 | 0.775 | 0.795 | 0.778 |

*Source:* Authors' Computation

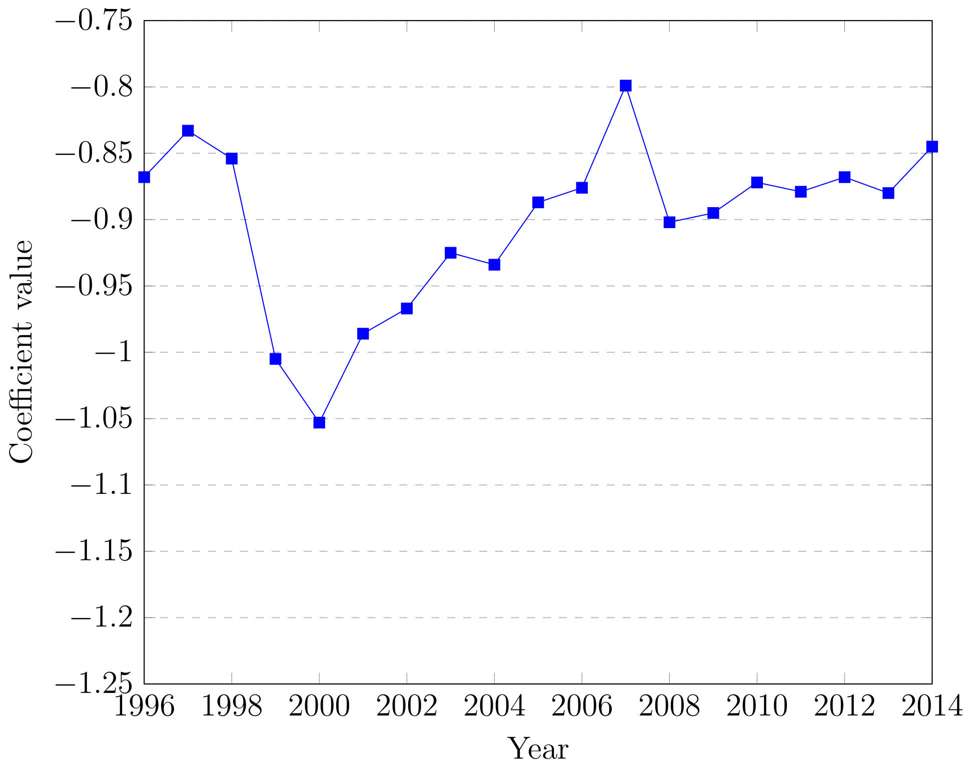


Figure 4.18: SITC 8 - Evolution of distance coefficient

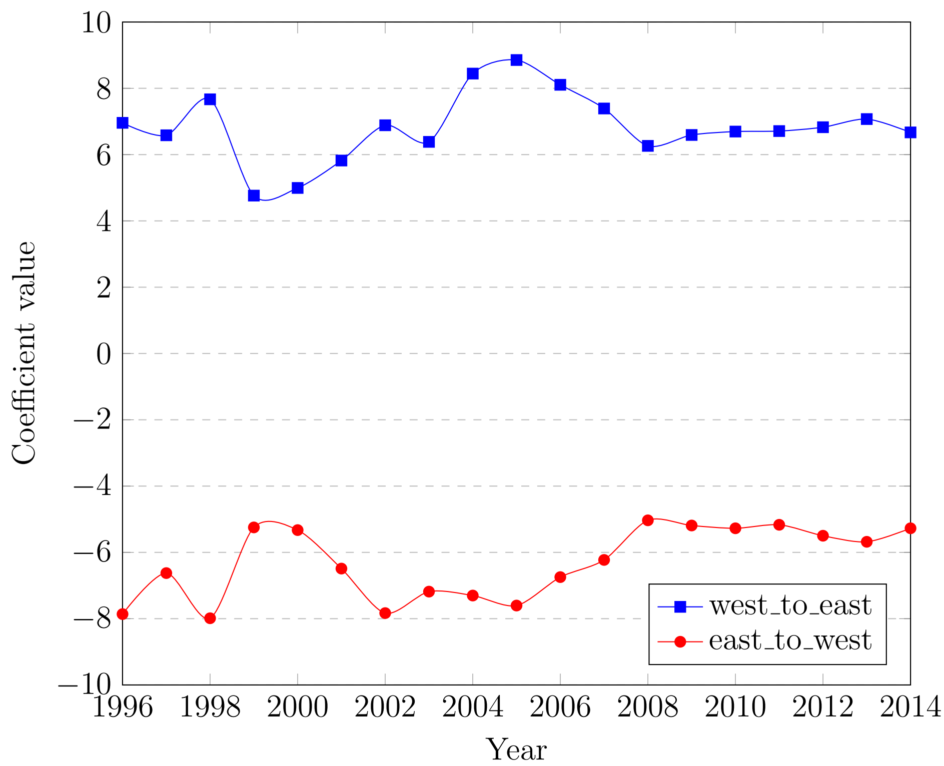


Figure 4.19: SITC 8 - Evolution of inter-bloc dummies

### 4.1.13 Section 9 - Commodities and transactions not classified elsewhere in the SITC

In regard to the $R^2$ value of 60%, Section 9 does not suit the gravity model well. The share of zero observations is the second highest of all the sections of trade. There is a 21% share as there are 2808 zero observations in the data. Over the observed period, the distance coefficient was initially insignificant and highly variable later on. Quite the same holds for the inter-bloc dummies. This is caused by this being the "section of the last resort" with often rather confusing results caused by ad hoc goods flows. Due to this, the inter-bloc dummies are not represented here in the form of a graph, but they can be found in the Appendix A in their complete form.

Table 4.11: Section 9 – Results Overview

| | 1996 | 2000 | 2004 | 2007 | 2011 | 2014 |
|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.807*** | 0.955*** | 0.980*** | 0.915*** | 0.954*** | 0.812*** |
| | (0.101) | (0.0787) | (0.0852) | (0.0692) | (0.0645) | (0.0671) |
| ln_expGDPinmil | 1.854*** | 1.410*** | 1.343*** | 1.216*** | 1.471*** | 1.162*** |
| | (0.345) | (0.133) | (0.0988) | (0.0919) | (0.0919) | (0.0959) |
| MR_ln_distw | 0.126 | -0.654* | -0.791*** | -0.681** | -0.848*** | -0.610** |
| | (0.465) | (0.343) | (0.268) | (0.293) | (0.188) | (0.273) |
| MR_west_to_east | 30.93** | -30.80*** | -23.33*** | -19.82*** | -11.98** | -8.263 |
| | (13.77) | (6.990) | (5.048) | (5.133) | (5.295) | (5.279) |
| MR_east_to_west | -28.93** | 30.65*** | 22.65*** | 20.57*** | 12.89** | 8.234 |
| | (12.81) | (7.059) | (4.864) | (5.268) | (5.358) | (5.498) |
| Observations | 650 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.682 | 0.682 | 0.609 | 0.548 | 0.772 | 0.670 |

*Source:* Authors' Computation

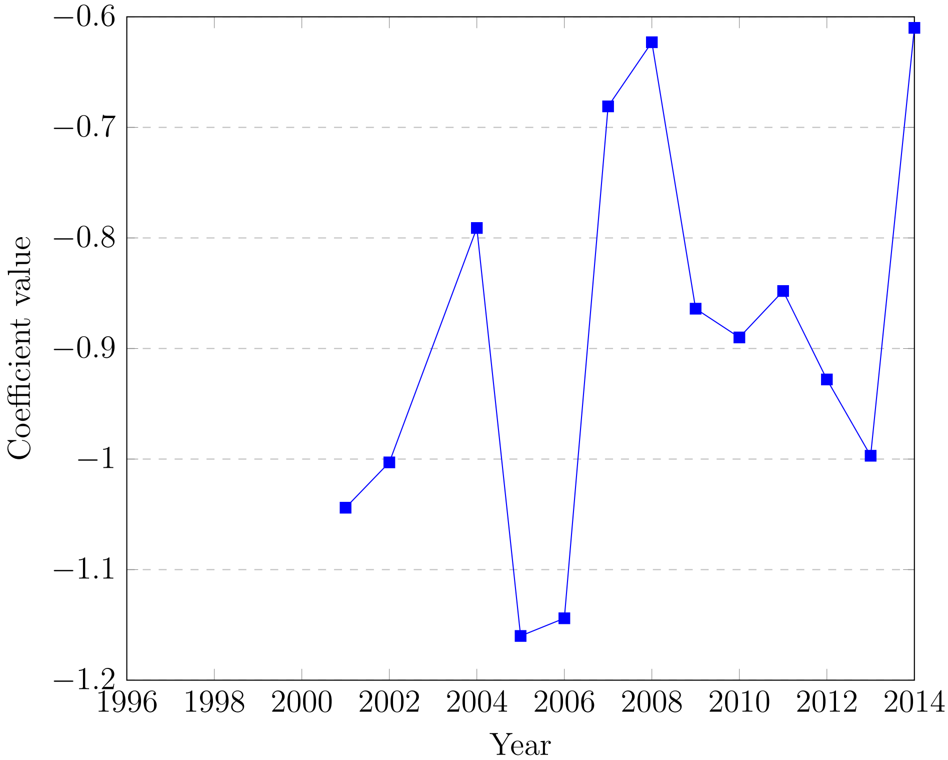


Figure 4.20: SITC 9 - Evolution of distance coefficient

# Chapter 5

# Discussion

## 5.1 Sections of Trade

Firstly, let us discuss the results from the re-aggregated data, concentrating on single sections of trade, their performance and appropriateness of the analysis. A complete list of the single sections can be found in Appendix A.

### 5.1.1 Aggregated and Re-aggregated Results

At first sight, it is apparent that the re-aggregated results presented some performance qualities. This is due to the fact that the explanatory variables contain a set of section dummies, which have enabled the model to partly take account of sections' heterogeneity. Model's $R^2$ of 75% offers an average value of single SITC sections, whereas the $R^2$ of the simple aggregated model is only 32%. The distance coefficient that works as a globalization proxy has been negatively affected by the Great Recession and the economical struggles around the turn of the millennium (discussed below), yet a trend of increasing globalization is noticeable. We can state that we are able to confirm the findings of Siliverstovs & Schumacher (2008) that the usage of Baier & Bergstrand (2007) approach is appropriate for observing the globalization puzzle on aggregated trade. On the other hand the model surges on underlying heterogeneity hidden in single sections. As a result of this, the *west_to_east* dummy variable is statistically significant only in one year. The dummy for the opposite direction is significant in none of the observed years.

### 5.1.2 Single Sections' Results

In this part single sections, which have been observed separately, are discussed. The complete estimation of the results can be found in Appendix A. Main conclusions about single sections are provided below.

#### Section 0 - Food and live animals

Section 0 is a good example of decrease of the distance coefficient. The driver of this change could be caused primarily by the elimination of the non-monetary barriers that came about due to the mutual recognition of goods. Also, because the category of food, beverages and tobacco is, according to Eurostat, the first category in road transport (18.9% share on the tonne-kilometres Eurostat (2015)), and since live animal transportation is also mainly a domain of road transportation, an increase in the quality of infrastructure and the entry into the Schengen Area have decreased the cost and length of transportation. Thus we may conclude that the level of globalization appears to increase over the observed period in spite of the negative impact of the Great Recession, as the estimated coefficient has decreased by 4% (Its 2014 value represents a 10600 USD decrease in value in trade with a one percent increase in distance). Here we have to note that 9 members entered the Schengen area on December 21st 2007, i.e. at the beginning of the Great Recession. This driver of distance coefficient decrease was absorbed by the recession. A similar trend follows also within the other trade flows.

Additionally, the agriculture support policy of the EU and the strategical status of its production does not suggest that either of the blocs would specialize in agriculture and food production. This assumption is supported by the inter-bloc dummy variables, which although being statistically significant only in 4 respectively 3 periods is there an observable declining trend and convergence between the blocs. Furthermore, there are observable traces of Eastern Europe and especially Poland being strong in agriculture, which is evolving into a persistent trade advantage of Eastern Bloc.

#### Section 1 - Beverages and tobacco

An 8% decrease of the distance coefficient between 1996 and 2014 can be found in SITC Section 1. This increase in globalization could have similar drivers as food and live animals in Section 0. The negative effect of the Great Recession, that is not as intense here as it is in other sections, did not overweigh other drivers of the coefficient decrease. Unlike in Section 0, no convergence can be observed on the inter-bloc trade. Alcoholic and also non-alcoholic beverages are often consumed based on local taste and traditions and thus the persistent preference of local products consumption might affect the estimates. Also some countries are renowned for their products, such as France for wine, and this leads to their persistent higher share of exports. Moreover, generally alcohol consumption habits vary between Eastern and Western Europe.

### Section 2 - Crude materials, inedible, except fuels

The trade within this section is constrained by the richness of resources of single countries, and the gravity model is unable to intuitively cover for these attributes. On the other hand most of the countries possess those types of natural resources which they are able to trade. The distance coefficient substantially fluctuates during this period of time and is heavily affected by the crisis, as can be seen on the 35% jump between 2007 and 2011. The *west_to_east* dummy is statistically significant on $\alpha = 5\%$ level only in the years 2008 and 2010. The dummy for the opposite direction in this period is only significant on $\alpha = 10\%$ level. Within the other time periods it is not significant at all. The advantage in export of the Western Bloc can be observed in these two years. One explanation could be that the processing of crude materials is generally more labor intensive and in Eastern Europe labor costs are lower and thus there is an incentive to outsource their production the Eastern Bloc.

### Section 3 - Mineral fuels, lubricants and related materials

This section consists of following divisions: Coal, coke and briquettes, Petroleum, petroleum products and related materials, Gas, natural and manufactured, and Electric current. Except for the electric current, Section 3 is even more constrained in resources than Section 2. Moreover gas and oil are usually intracontinentally transported through a system of pipelines. The pipeline infrastructure, built mainly during the Cold War, was built separately inside the two blocs. Although in the last 25 years links have been built between the blocs, the systems are still not fully interconnected. The oil fields are almost exclusively located Western-Europe[1]

The situation is very similar in the case of natural gas. Coal products are

[1] The UK possesses a larger amount of reserves that the rest of Europe. The next country with the highest oil reserves is Denmark, followed by the Netherlands, Italy and Germany.

usually consumed locally due to their bulkiness and homogeneity. The dummy variables do suggest a high advantage for the West to East trade direction and the evidence seems to be of decreasing trend. But overall the gravity model does not suit this section very well as it explains only 57% of the variance. There is a lot of unexplained variation left and thus it is not suggestable to rely on the findings in this section too heavily.

### Section 4 - Animal and vegetable oils, fats and waxes

Out of all observed sections, Section 4 performs the worst, with $R^2$ of 51%. The distance coefficient, that has an average value of -1.77, fluctuates noticeably but appears to have decreased since 2011. The inter-bloc dummies are significant in 82% cases on average and they appear to converge from 2002 onward. The advantage of the Eastern Bloc is persistent as the East to West trade appears to have 96 610 USD higher value than the reference intra-blocs trade in 2012. The average value of the East to West trade dummy is 21.7 and -23.2 for the opposite direction. Nevertheless, due the very low $R^2$ value, the fit of this section to the gravity model is not good and we would recommend not to rely on its findings.

### Section 5 - Chemicals and related products, n.e.s.

The section on chemicals appears to explain the model fairly well. An interesting finding here is that in the first period until the year 2001 the goodness of fit was around 83% but suddenly it drops to 66%. Apparently a new unknown explanatory variable is behind this, unfortunately we have not found its origin. The inter-bloc trade dummy variables suggest that there is a convergence in the data, thus that any of the blocs do not increase in specialization. To be precise, between years 1999 and 2014 the advantage of the Eastern Bloc decreased by 33% and the disadvantage of Western Bloc decreased by 36%.

### Section 6 - Manufactured goods classified chiefly by material

Manufactured goods are usually of high value. This is reflected by a rather low distance coefficient. In other words the distance does not affect the amount of trade within this section. The average value of the distance coefficient is -0.75 — so an increase of distance by 1% decreases the value of trade by 7 500 USD. The intra-bloc trade dummies suggest a convergence between the blocs as the estimated coefficients show that the advantage of Eastern Bloc had decreased between 1999 and 2011 by 25% and the disadvantage of the Western Bloc decreased in the same period by 63%. The advantage of the Eastern Bloc could be accounted for by historically lower wages, which have led western companies to move their production plants to eastern countries and kept their research and development centers in home countries. Over time, however, there was a relative increase in wages in the Eastern Bloc respective to the Western Bloc and the production was due to the costs shifting to farther eastern countries. This could be one explanation for the observed inter-bloc convergence.

#### Section 7 - Machinery and transport equipment

This section is one of the best fitting to the gravity model with its substantially high $R^2$ value of 83%. The distance coefficient decreased by 27% between the first and the last year of observation. The inter-bloc dummies coefficient suggests an increase in west to east trade advantage by 22% from 2005 to 2014 and decrease the other way around by 62%. This trend is in line with the New Trade Theory that suggests a specialization of a country or a group of similar countries. The goods in this sector are generally of high added value, which requires skilled labor in their production. This skill intensity and value can be one reason why Western Bloc companies keep their factories in home countries. The high value of goods also explains the low value of the distance coefficient, which reflects the favorable value-weight ratio.

Furthermore, there is evidence for the decrease of the goodness of fit by about 10 percentage points starting in 2007. One of the explanations is that as the Eastern European countries entered the EU, there was an increased incentive in foreign direct investment from the companies to open factories in the opposite Bloc countries; hence these markets were supplied by the newly opened local factories. Another possible driver of this decrease are the two regional trade agreement dummies. The first loses its functionality when 10 former Eastern Bloc countries join the EU in the year 2004. In 2007 the second dummy loses its power as the remaining two countries also become members of the EU, making all the countries in dataset part of the European Union.

#### Section 8 - Miscellaneous manufactured articles

This section consists of a group of heterogeneous articles such as building materials and furniture, clothes, footwear, professional instruments, photographic apparatus, watches and others. Because of that, this section may contain a lot of underlying heterogeneity as well as opposing trends. Although the goodness of fit of this section was one of the best, a persistent trend in the increase of the globalization could not be observed between the years 1996 and 2014. One may argue that before the Great Recession in 2007 there was a significant decrease of the coefficient. But as the observation of the decrease was only in one year, it could also have been an outlier and even after that the decreasing trend is very gradual. In case of the dummy variables, there is negligible change in the *west_to_east* variable whereas the *east_to_west* increased by about 33% from -7.8 to -5.3 between the years 1996 and 2014.

#### Section 9 - Commodities and transactions not classified elsewhere in the SITC

Section 9 is an additional section, which contains the type of goods that do not fit in any of the previous sections. Due to this fact, it covers many ad hoc relations, where a different underlying trends may be presumed. Low $R^2$ value and coefficient jumping from year to year show that this section is not appropriate for the estimation and thus it would be superfluous to further discuss it.

## 5.2 Results Summary

Evolution of the distance coefficient as well as the average $R^2$ values varies greatly among the sections. The table 5.1 below provides a comparison of their values.[2] Overall, a decrease of distance coefficient is observed in 8 out of 9 sections. The magnitude of the decrease varies. In Sections 3, 4, 6 and 7 the decrease exceeded 10% between 1996 and 2014 and we can state that these sections appear to react the fastest to proceeding globalization between the two blocs of countries. Due to the observed trend in Section 5, which does not show any decrease, we are unable to confirm our hypothesis that the level of globalization has increased in all of the observed sections. On the other hand, we can confirm the hypothesis that the development of single sections had not been following a similar patterns. In all of the sections sensitivity of distance coefficient on recessions was observed, yet with varying magnitude. This issue is discussed below. In 2014, the increase in distance has the lowest

[2]With exception of Section 9 whose drop was discussed above.

impact on trade value in Sections 6 and 7. On the contrary, the most distance sensitive trade articles are in Sections 3 and 4. These findings are in line with the assumption that the higher the value-weight ratio and the easier the transportation, the lower the effect, which distance has on trade volume.

Table 5.1: $R^2$ and Distance Coefficient Evolution Comparison

| SITC Section | Average $R^2$ | Distance coefficient | | | |
|---|---|---|---|---|---|
| | | 1996 | 2014 | Δ | Δ % |
| 0 | 80% | -1.11 | -1.06 | 0.05 | -4% |
| 1 | 69% | -1.25 | -1.15 | 0.10 | -8% |
| 2 | 67% | -0.75 | -0.69 | 0.06 | -8% |
| 3 | 57% | -2.15 | -1.86 | 0.28 | -13% |
| 4 | 51% | -1.82 | -1.53 | 0.29 | -16% |
| 5 | 72% | -0.99 | -0.98 | 0.00 | 0% |
| 6 | 80% | -0.69 | -0.61 | 0.08 | -11% |
| 7 | 83% | -0.85 | -0.62 | 0.23 | -27% |
| 8 | 78% | -0.87 | -0.85 | 0.02 | -3% |

*Source:* Authors' Computation

Another goal of this study was to measure convergence or divergence between the Eastern and Western Bloc. The divergence could be explained by the New Trade Theory, which assumes specialization of the countries, presuming that eastern and western countries share a number of characteristics. The convergence could, on the other hand, arise from equalization of the economic conditions, competitiveness, production technologies and standards of living. The inter-bloc trade dummies distinguish the direction of trade. The intra-bloc trade is taken as a base category. The blocs diverge and Eastern Bloc appears to specialize in beverages and tobacco, the Western Bloc, by contrary, specializes in machinery and transport equipment. Here, however, the East to West trade seems to improve slightly towards the intra-blocs trade. A convergence between the blocs was observed in all other sections. The highest percentage change was observed in Sections 0 and 6, where the initial coefficients have approximately halved. Section 0 also has the lowest absolute value of the inter-bloc dummies — East to West trade is expected to be higher by 3.3 million USD compared to intra-blocs trade and also higher by 6.4 Mil USD than the west to east trade per country pair. The lowest percentage change of about 5% is to be seen in Section 2 containing crude materials. The highest absolute difference between the blocs is in Section 5 containing chemicals. Here as of

2014 the value of East to West trade from any eastern exporter to any western importer is expected to be higher by 11.8 Mil USD in comparison with intra-blocs trade and by 24.3 Mil USD in comparison with west to east trade. Further comparison of inter-bloc dummies can be found in the table 5.2 below.

Table 5.2: Inter-bloc Dummies Comparison

| SITC Section | West to East Trade | | | | East to West Trade | | | |
|---|---|---|---|---|---|---|---|---|
| | Inivial value | Final value | delta | delta % | Inivial value | Final value | delta | delta % |
| 0 | -8.8 | -3.1 | 5.69 | -65% | 6.8 | 3.3 | -3.54 | -52% |
| | 1999 | 2011 | | | 1999 | 2011 | | |
| 1 | -8.8 | -10.7 | -1.95 | 22% | 6.5 | 8.3 | 1.88 | 29% |
| | 2000 | 2006 | | | 2000 | 2006 | | |
| 2 | 5.2 | 5.0 | -0.24 | -5% | -4.5 | -4.2 | 0.28 | -6% |
| | 2008 | 2010 | | | 2008 | 2010 | | |
| 3 | 15.6 | 9.7 | -5.88 | -38% | -19.8 | -9.3 | 10.45 | -53% |
| | 2002 | 2010 | | | 2002 | 2010 | | |
| 4 | -16.7 | -10.6 | 6.15 | -37% | 16.0 | 9.7 | -6.30 | -39% |
| | 1996 | 2012 | | | 1996 | 2012 | | |
| 5 | -19.4 | -12.5 | 6.89 | -36% | 17.8 | 11.8 | -5.94 | -33% |
| | 1999 | 2014 | | | 1999 | 2014 | | |
| 6 | -6.0430 | -2.2430 | 3.80 | -63% | 4.4330 | 2.6720 | -1.76 | -40% |
| | 1999 | 2011 | | | 1999 | 2014 | | |
| 7 | 4.125 | 5.375 | 1.25 | 30% | -4.0860 | -4.0140 | 0.07 | -2% |
| | 2004 | 2014 | | | 1998 | 2014 | | |
| 8 | 6.96 | 6.67 | -0.29 | -4% | 7.86 | -5.27 | 2.59 | -33% |
| | 1996 | 2014 | | | 1996 | 2014 | | |

*Source:* Authors' Computation

### Recession as a Driver Against the Globalization

In every one of the observed sections one universal development can be observed — a decrease in globalization during the crises. One of these periods is the Great Recession, which started in the late 2007 and was followed by the European sovereign debt crisis two years later and continues in lower magnitude up to present day. The lag in reaction varies across the sections. Some Sections, as for example 2 or 5 react as early as the year 2008, whereas an increase in the distance coefficient of others, such as Section 0, can be observed as late as 2011. Also the effect of the crisis varies highly among the sections. The most affected seems to be Section 5 — Chemicals and related products. This section's distance coefficient increased by 64% between 2007 and 2012. Whereas the Section 0 — Food and live animals — have proven to be stable with an increase of only 7% during the same period. Reason of stability of this section is that a food is generally a necessity good.

An increase of higher magnitude can be observed for the period around the millennium. We suggest that this increase is driven by multiple factors: uncertainty brought by the 1997 Asian Financial Crisis, Dot-com bubble, Telecom's crash, instability of the Euro as the currency plummeted after its introduction, 2001 Germany's and France's recessions and high inflation in the late 1990s inside some transforming economies. On the other hand, 9 countries entered the Schengen Area during the Great Recession period and the price of oil have rapidly decreased, and these indisputable globalization drivers decreased the recession effect. Furthermore, in the period around the millennium, the magnitude of distance coefficient was different in single sections - in Section 5 the coefficient grew by 27% meanwhile in Section 6 it grew by a full 67%. Moreover we observe that the effect on single sections is not interconnected between the two periods e.g. the distance coefficient of Section 8 grew by 23% between 1998 and 2000 whereas between 2007 and 2009 it only grew by 13%. On the other hand, Section 5 grew by 7% in the first period and by 64% during the Great Recession. We can therefore confirm hypothesis about the negative impact of the Great Recession on every one of the sections. Interestingly enough, the economical struggles around the turn of the millennium affected some sections more than others.

# Chapter 6

# Conclusion

This thesis measures the development of distance coefficient, known as a proxy for the level of globalization, on a disaggregated trade flows in the period between 1996 and 2014 on a dataset of 27 EU countries. Besides making observations on the development of the globalization proxy, our further goal was to observe the convergence between the "Western Bloc" — those members of EU 27 not connected to the Soviet Union — and the "Eastern Bloc" — 10 post-communist EU 27 members. As we worked with trade flows disaggregated into 10 sections of trade, we had the opportunity to observe the differences between them and their response ability to new political and economic conditions.

To observe inter-bloc trade, we introduced a new modification of one typical gravity model explanatory variable, which is traditionally used to cover for the historical relations between observed countries. This is often used for countries that have been colonized by the same power. We have considered that being part of one bloc builds similar historical ties to the common colonizer ties. The typical approach would suggest introducing dummy variables of trade within the Eastern Bloc and the Western Bloc. However, as we intended to focus on inter-blocs trade, we decided to introduce a modification of this dummy — a variable that focuses on inter-blocs trade and uses the trade within single blocs as a base state. Since we wanted to observe differences between single directions, we further introduced a division of this variable on *east_to_west* and *west_to_east* trade dummies. Subsequent estimations were done in accordance with the Taylor-series approximation model by Baier & Bergstrand (2009) using a Pseudo Maximum Likelihood (PPML) estimator proposed by Santos Silva and Tenreyro (2006).[1]

[1]As there is almost 10% of zero observations present in our dataset, the OLS estimator cannot be used, since its usage would lead to a selection bias.

Applying this methodology cross-sectionally year-by-year on single sections produced an average $R^2$ value of 70%. Subsequently, we focused on a yearly evolution of the variables of interest — distance and inter-bloc trade variables. The distance coefficient was significant in every case.[2] Observing its evolution within single sections, we have found that the level of globalization increased in 9 out of 10 sections. In the last section the coefficient remained unchanged. The magnitude of the changes varies as well as their development. Hence we can confirm the hypothesis that the development of single sections did not follow similar patterns. Also the observed differences between the speed of adaptability, stability and absolute values of single sections' coefficients provide interesting insight on international trade flows. We found that the highest level of globalization is in the trade of goods of high value namely in Sections 6 of Manufactured goods, characterized chiefly by material and Section 7 of Machinery and transport equipment, where there was also the highest decrease of the coefficient — 27% between 1996 and 2014. On the other hand, the most stable distance coefficient is in Section 5 of Chemicals and related products (0% change in the respective period) and Section 0 of Food and live animals (3% change). Section 3 of Mineral fuels, lubricants and related materials had the highest value of distance coefficient in 2014.

The second goal was to observe inter-blocs trade and search for traces of convergence or divergence. We have found that only Sections 1 and 7 have diverged. We explain this divergence as an increase in specialization of the blocs as the New Trade Theory would suggest. The other sections have shown evidence of convergence, which can be explained by equalization of the economic conditions, competitiveness, production technologies and standards of living. The speed of convergence and the absolute values differ widely between the sections. Additionally, we have found that effect of crises on single sections varies greatly. Single sections show different reactions to different types of crises, where one section's distance coefficient may be highly affected by one crisis but a second leaves the coefficient almost unaffected. Generally a substantial heterogeneity and often opposite trends have been found in different sections. This explains why the inter-bloc dummies become insignificant once the model is applied on the re-aggregated trade.

Trade amount as well as the level of globalization are significant drivers of GDP and a living standards. Their better understanding helps to introduce

[2]With exceptions of first 6 years in Section 9 that is as discussed above generally unsuitable for gravity models and thus not further discussed.

policies to increase public welfare. Being among the first to do this, we introduce an application of the gravity model to measure globalization level. Our findings provide another insight on the process of globalization and its evolution within single trade sections. The observed differentiating sensitivity of single sections to recessions provides an impulse for policy setting. Further, our application of the model on transitive economies could help one while estimating the development of trade in any transitive economy.

An interesting extension of this research would be to take any section, which have here proven to work well under a gravity model, and disaggregate them into single divisions, groups or subgroups and repeat our experiment. An even more intriguing extension could be to build an indices of business cycle indicators such as change of GDP, inflation, unemployment rate, investment spending, capacity utilization or rate of bankruptcies. Assuming that countries in expansion purchase and produce more and thus the value imports and exports rises, business cycle expression trough these indices would bring a supporting explanatory variables, which would more precisely measure the relation between economic activity and the distance coefficient. Also thanks to this incorporation, one could observe the sensitivity of trade to business cycles.

# Bibliography


ANDERSON, J. E. (1979): "A theoretical foundation for the gravity equation." *The American Economic Review* **69(1)**: pp. 106–116.

ANDERSON, J. E. & E. VAN WINCOOP (2003): "Gravity with Gravitas : A Soiution to the Border Puzzie." *The American Economic Review* **93(1)**: pp. 170–192.

BACCHETTA, M., C. BEVERELLI, O. CADOT, M. FUGAZZA, J.-M. GRETHER, M. HELBLE, A. NICITA, & R. PIERMARTINI (2012): *A Practical Guide to Trade Policy Analysis.* WTO.

BAIER, S. L. & J. H. BERGSTRAND (2007): "Do free trade agreements actually increase members' international trade?" *Journal of International Economics* **71(1)**: pp. 72–95.

BAIER, S. L. & J. H. BERGSTRAND (2009): "Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation." *Journal of International Economics* **77(1)**: pp. 77–85.

BALDWIN, R. & D. TAGLIONI (2006): "Gravity For Dummies And Dummies For Gravity Equations." *Nber Working Paper Series* **12516**: p. 31.

BALDWIN, R. E. & WYPLOSZ CHARLES (2012): *The Economics of European Integration.* London: McGraw Hill Higher Education, 4th ed edition.

BERGSTRAND, J. H. (1989): "The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade." *The Review of Economics and Statistics* **71(1)**: pp. 143–53.

BERTHELON, M. & C. FREUND (2008): "On the conservation of distance in international trade." *Journal of International Economics* **75(2)**: pp. 310 – 320.

Burger, M., F. van Oort, & G.-J. Linders (2009): "On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-inflated Estimation." *Spatial Economic Analysis* **4(2)**: pp. 167–190.

Caruso, R. (2003): "The Impact of International Economic Sanctions on Trade: An Empirical Analysis." *Peace Economics, Peace Science, and Public Policy* **9(2)**: pp. 1–34.

Chai, H. S. & K. R. Bailey (2008): "Use of log-skew-normal distribution in analysis of continuous." *Statistics in medicine* **27(18)**: pp. 3643–3655.

Coe, D., A. Subramanian, N. T. Tamirisa, & R. Bhavnani (2002): "The Missing Globalization Puzzle." *IMF Working Paper* **2002(2171)**: p. 30.

Eaton, J. & S. Kortum (2002): "Technology, Geography, and Trade." *Econometrica* **70(5)**: pp. 1741–1779.

Eichengreen, B. & D. A. Irwin (1996): "The Role of History in Bilateral Trade Flows." *NBER Working Papers* **(5565)**: p. 53.

Eurostat (2015): "Road freight transport by type of goods." [ONLINE] Availiable at: `http://ec.europa.eu/eurostat/statistics-explained/index.php/Road_freight_transport_by_type_of_goods` [Acccessed: 5 April 2016].

Francois, J. & M. Manchin (2013): "Institutions, Infrastructure, and Trade." *World Development* **46**: pp. 165–175.

Helpman, E., M. Melitz, & Y. Rubinstein (2008): "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics* **123(2)**: pp. 441–487.

Hornok, C. (2011): "Gravity or Dummies? The Limits of Identification in Gravity Estimations." *CeFiG Working Papers* **15(August)**: pp. 1–23.

International Monetary Fund (2000): "Globalization: Threat or opportunity?" [ONLINE] Availiable at: `https://www.imf.org/external/np/exr/ib/2000/041200to.htm` [Acccessed: 10 April 2016].

International Trade Centre (2016): "Difference between the Standard International Trade Classification (SITC) and the Harmonized System (HS)." [ONLINE] Availiable at: `http://legacy.intracen.org/mas/sitchs.htm` [Acccessed: 10 February 2016].

Krugman, P. (1979): "Increasing returns, monopolistic competition, and international trade." *Journal of International Economics* **9(4)**: pp. 469–479.

Martin, W. & C. S. Pham (2008): "Estimating the Gravity Model When Zero Trade Flows are Frequent." *Deakin University Economics Series* **2008(03)**: p. 46.

Moulton, B. R. (1990): "An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Unit." *The Review of Economics and Statistics* **72(2)**: pp. 334–38.

Prehn, S. & B. Brummer (2011): "Estimation Issues in Single Commodity Gravity Trade Models." *German Association of Agricultural Economists* **2011(114776)**.

Santos Silva, J. M. C. & S. Tenreyro (2006): "The Log of Gravity." *The Review of Economics and Statistics* **88(4)**: pp. 641–658.

Santos Silva, J. M. C. & S. Tenreyro (2011): "Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator." *Economics Letters* **112(2)**: pp. 220–222.

Shepherd, B. (2012): *The Gravity Model of International Trade: A User Guide*. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

Siliverstovs, B. & D. Schumacher (2008): "Disaggregated Trade flows and the Missing Globalization Puzzle." *KOF Working Papers* **115(209)**: pp. 141–164.

Solleder, O. (2013): "Panel Export Taxes (PET) Dataset: New Data on Export Tax Rates." *International and Development Studies Working Paper* **2013(07)**: p. 44.

de Sousa, J. (2012): "The currency union effect on trade is decreasing over time." *Economics Letters* **117(3)**: pp. 917–920.

Staub, K. E. & R. Winkelmann (2011): "Consistent estimation of zero-inflated count models." *SOI - Working Papers* **7041(0908)**: p. 25.

Tinbergen, J. (1962): *Shaping the world economy: suggestions for an international economic policy*. The Twentieth Century Fund.

Vicarelli, C., M. Cipollina, L. Salvatici, & L. D. Benedictis (2013): "A Note on Dummies for Policies in Gravity Models : a Montecarlo Experiment." *Departmental Working Papers of Economics - University 'Roma Tre'* pp. 1–10.

Yilmazkuday, H. (2013): "A Solution to the Missing Globalization Puzzle by Non-CES Preferences." *SSRN Electronic Journal* **2258804**: p. 31.

# Appendix A

# Complete Results

Appendix A contains a complete results of the aggregated, re-aggregated model and of all 10 SITC Sections as well. The dataset and the source code can be provided by author on request.

Table A.1: Aggregated PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.89*** | 0.87*** | 0.87*** | 0.88*** | 0.87*** | 0.88*** | 0.86*** | 0.90*** | 0.85*** | 0.84*** | 0.83*** | 0.83*** | 0.84*** | 0.85*** | 0.85*** | 0.86*** | 0.86*** | 0.85*** | 0.85*** |
| | (0.05) | (0.05) | (0.04) | (0.03) | (0.03) | (0.03) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| ln_expGDPinmil | 0.91*** | 0.87*** | 0.90*** | 0.89*** | 0.88*** | 0.89*** | 0.88*** | 0.91*** | 0.87*** | 0.86*** | 0.87*** | 0.86*** | 0.87*** | 0.87*** | 0.86*** | 0.85*** | 0.84*** | 0.82*** | 0.83*** |
| | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| MR_ln_distw | -0.90*** | -0.92*** | -0.82*** | -1.09*** | -1.10*** | -1.07*** | -1.04*** | -0.95*** | -0.90*** | -0.87*** | -0.89*** | -0.77*** | -0.84*** | -0.83*** | -0.84*** | -0.97*** | -0.99*** | -0.97*** | -0.89*** |
| | (0.17) | (0.19) | (0.20) | (0.13) | (0.13) | (0.11) | (0.11) | (0.13) | (0.13) | (0.13) | (0.13) | (0.16) | (0.17) | (0.16) | (0.16) | (0.17) | (0.17) | (0.18) | (0.18) |
| MR_contig | 0.28** | 0.31** | 0.32** | 0.06 | 0.10 | 0.07 | 0.17 | 0.20 | 0.26 | 0.30* | 0.29* | 0.43** | 0.42* | 0.42** | 0.48** | 0.41* | 0.40* | 0.45** | 0.51** |
| | (0.14) | (0.15) | (0.16) | (0.13) | (0.15) | (0.13) | (0.14) | (0.15) | (0.17) | (0.17) | (0.17) | (0.20) | (0.21) | (0.21) | (0.21) | (0.22) | (0.22) | (0.23) | (0.22) |
| MR_comlang | 0.02 | -0.09 | -0.05 | 0.54*** | 0.47*** | 0.50*** | 0.51*** | 0.51** | 0.48** | 0.45* | 0.45* | 0.45* | 0.49** | 0.52** | 0.47* | 0.41* | 0.34 | 0.32 | 0.28 |
| | (0.47) | (0.44) | (0.42) | (0.15) | (0.15) | (0.14) | (0.16) | (0.21) | (0.23) | (0.24) | (0.24) | (0.26) | (0.25) | (0.23) | (0.24) | (0.22) | (0.23) | (0.26) | (0.24) |
| MR_west_to_east | 1.08 | 0.37 | 0.91 | -2.55** | -2.06* | -1.91* | -0.93 | -1.15 | 0.97 | 0.92 | 0.44 | 0.08 | 0.14 | 1.84 | 1.92* | 1.54 | 1.25 | 1.04 | 1.28 |
| | (2.39) | (2.15) | (1.97) | (1.21) | (1.08) | (1.04) | (1.07) | (1.12) | (1.10) | (1.12) | (1.08) | (1.12) | (1.15) | (1.28) | (1.14) | (1.15) | (1.12) | (1.16) | (1.10) |
| MR_east_to_west | -2.78 | -1.49 | -2.17 | 1.27 | 1.10 | 0.78 | -0.04 | -0.23 | -0.12 | 0.03 | 0.71 | 0.91 | 0.84 | -0.68 | -0.75 | -0.33 | -0.23 | -0.05 | -0.32 |
| | (2.32) | (2.14) | (2.00) | (1.21) | (1.11) | (1.08) | (1.11) | (1.12) | (1.07) | (1.10) | (1.10) | (1.24) | (1.28) | (1.43) | (1.32) | (1.30) | (1.26) | (1.29) | (1.24) |
| MR_EU | -1.12* | -0.84 | -1.15* | -0.22 | -0.57 | -0.40 | -0.51 | -0.58 | | | | | | | | | | | |
| | (0.66) | (0.67) | (0.59) | (0.64) | (0.65) | (0.68) | (0.65) | (0.70) | | | | | | | | | | | |
| MR_nonEUrta | 0.07 | -0.23 | 0.16 | 0.79 | 0.61 | 0.98 | 0.94 | 1.24* | 0.30 | 0.47 | 0.21 | | | | | | | | |
| | (0.56) | (0.51) | (0.49) | (0.71) | (0.72) | (0.72) | (0.69) | (0.72) | (1.76) | (1.23) | (1.05) | | | | | | | | |
| MR_landlock_imp | 7.09 | 9.48** | 10.86*** | 8.13** | 7.23** | 9.21*** | 9.43*** | 8.94*** | 9.59*** | 9.47*** | 10.31*** | 11.65*** | 12.07*** | 10.66*** | 11.39*** | 11.29*** | 11.55*** | 10.57*** | 11.72*** |
| | (4.33) | (4.42) | (3.83) | (3.30) | (3.36) | (3.01) | (2.91) | (2.94) | (3.22) | (3.14) | (3.15) | (3.18) | (3.12) | (3.22) | (3.27) | (3.31) | (3.40) | (3.45) | (3.44) |
| MR_landlock_exp | 10.96** | 10.75** | 9.88** | 8.78** | 7.62** | 9.21*** | 7.61** | 8.64** | 8.66** | 8.44** | 8.23** | 9.17** | 9.38** | 10.27** | 11.52*** | 11.43*** | 11.64*** | 11.60*** | 11.55*** |
| | (5.37) | (5.40) | (5.00) | (3.95) | (3.74) | (3.46) | (3.44) | (3.69) | (3.88) | (3.89) | (3.76) | (4.06) | (4.01) | (4.28) | (4.20) | (3.88) | (3.95) | (3.95) | (3.99) |
| MR_comcol | 3.03*** | 2.92*** | 2.65*** | 2.32*** | 2.24*** | 2.49*** | 2.27*** | 2.55*** | 2.46*** | 2.47*** | 2.57*** | 2.63*** | 2.63*** | 2.90*** | 3.00*** | 2.85*** | 3.02*** | 2.90*** | 2.87*** |
| | (0.91) | (0.84) | (0.69) | (0.49) | (0.45) | (0.44) | (0.40) | (0.44) | (0.48) | (0.46) | (0.42) | (0.41) | (0.41) | (0.45) | (0.45) | (0.47) | (0.49) | (0.42) | (0.41) |
| MR_soc_bus_fnd | -0.05 | -0.06 | -0.08 | -0.04 | 0.02 | -0.03 | -0.01 | -0.07 | -0.07 | -0.08 | -0.07 | -0.06 | -0.05 | -0.06 | -0.07 | -0.02 | -0.00 | 0.01 | -0.01 |
| | (0.06) | (0.07) | (0.05) | (0.05) | (0.06) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) | (0.06) | (0.05) | (0.06) |
| MR_gov_fisc_fnd | -0.01 | -0.04 | -0.06 | -0.16*** | -0.13*** | -0.14*** | -0.12*** | -0.14*** | -0.15*** | -0.19*** | -0.17*** | -0.17** | -0.15** | -0.17** | -0.16** | -0.12 | -0.04 | -0.05 | -0.01 |
| | (0.06) | (0.06) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.06) | (0.06) | (0.06) | (0.07) | (0.06) | (0.07) | (0.07) | (0.08) | (0.09) | (0.10) | (0.09) |
| MR_trade_fnd | 0.15 | 0.17 | 0.09 | 0.32** | 0.11 | 0.13 | 0.06 | 0.18 | 0.10 | 0.03 | -0.16 | 0.14 | 0.10 | 0.16 | 0.24 | -0.30 | -0.58** | -0.41 | -0.44 |
| | (0.14) | (0.14) | (0.13) | (0.15) | (0.14) | (0.14) | (0.13) | (0.15) | (0.16) | (0.18) | (0.19) | (0.19) | (0.18) | (0.22) | (0.21) | (0.32) | (0.29) | (0.35) | (0.31) |
| Constant | 13.26 | 10.59 | 4.44 | 20.62 | 27.31** | 17.86 | 19.05* | 11.78 | 6.61 | 5.68 | 4.87 | -4.22 | -1.90 | -1.17 | -3.65 | 1.20 | 1.02 | 2.68 | -3.85 |
| | (17.85) | (18.99) | (17.22) | (13.39) | (12.10) | (11.20) | (11.18) | (13.44) | (13.42) | (13.44) | (12.51) | (13.88) | (13.27) | (13.55) | (14.08) | (12.90) | (13.99) | (14.55) | (14.98) |
| Observations | 6,500 | 6,500 | 6,500 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 |
| R-squared | 0.34 | 0.32 | 0.30 | 0.32 | 0.33 | 0.32 | 0.31 | 0.32 | 0.32 | 0.31 | 0.31 | 0.31 | 0.33 | 0.34 | 0.34 | 0.33 | 0.33 | 0.33 | 0.32 |
| Method | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated | Aggregated |

## Table A.2: Re-aggregated PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.89*** | 0.87*** | 0.87*** | 0.88*** | 0.87*** | 0.88*** | 0.86*** | 0.90*** | 0.85*** | 0.84*** | 0.83*** | 0.83*** | 0.84*** | 0.85*** | 0.85*** | 0.86*** | 0.86*** | 0.85*** | 0.85*** |
| | (0.05) | (0.05) | (0.04) | (0.03) | (0.03) | (0.03) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| ln_expGDPinmil | 0.91*** | 0.87*** | 0.90*** | 0.89*** | 0.88*** | 0.89*** | 0.88*** | 0.91*** | 0.87*** | 0.86*** | 0.87*** | 0.86*** | 0.87*** | 0.87*** | 0.86*** | 0.85*** | 0.84*** | 0.82*** | 0.83*** |
| | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| MR_ln_distw | -0.90*** | -0.92*** | -0.82*** | -1.09*** | -1.10*** | -1.07*** | -1.04*** | -0.95*** | -0.90*** | -0.87*** | -0.89*** | -0.77*** | -0.84*** | -0.83*** | -0.84*** | -0.97*** | -0.99*** | -0.97*** | -0.89*** |
| | (0.17) | (0.19) | (0.20) | (0.13) | (0.13) | (0.11) | (0.11) | (0.13) | (0.13) | (0.13) | (0.13) | (0.16) | (0.17) | (0.16) | (0.16) | (0.17) | (0.17) | (0.18) | (0.18) |
| MR_contig | 0.28** | 0.31** | 0.32** | 0.06 | 0.10 | 0.07 | 0.17 | 0.20 | 0.26 | 0.30* | 0.29* | 0.43** | 0.42* | 0.42** | 0.48** | 0.41* | 0.40* | 0.45** | 0.51** |
| | (0.14) | (0.15) | (0.16) | (0.13) | (0.15) | (0.13) | (0.14) | (0.15) | (0.17) | (0.17) | (0.17) | (0.20) | (0.21) | (0.21) | (0.21) | (0.22) | (0.22) | (0.23) | (0.22) |
| MR_comlang | 0.02 | -0.09 | -0.05 | 0.54*** | 0.47*** | 0.50*** | 0.51*** | 0.51** | 0.48** | 0.45* | 0.45* | 0.45* | 0.49** | 0.52** | 0.47* | 0.41* | 0.34 | 0.32 | 0.28 |
| | (0.47) | (0.44) | (0.42) | (0.15) | (0.15) | (0.14) | (0.16) | (0.21) | (0.23) | (0.24) | (0.24) | (0.26) | (0.25) | (0.23) | (0.24) | (0.22) | (0.23) | (0.26) | (0.24) |
| MR_west_to_east | 1.08 | 0.37 | 0.91 | -2.55** | -2.06* | -1.91* | -0.93 | -1.15 | 0.97 | 0.92 | 0.44 | 0.08 | 0.14 | 1.84 | 1.92* | 1.54 | 1.25 | 1.04 | 1.28 |
| | (2.39) | (2.15) | (1.97) | (1.21) | (1.08) | (1.04) | (1.07) | (1.12) | (1.10) | (1.12) | (1.08) | (1.12) | (1.15) | (1.28) | (1.14) | (1.15) | (1.12) | (1.16) | (1.10) |
| MR_east_to_west | -2.78 | -1.49 | -2.17 | 1.27 | 1.10 | 0.78 | -0.04 | -0.23 | -0.12 | 0.03 | 0.71 | 0.91 | 0.84 | -0.68 | -0.75 | -0.33 | -0.23 | -0.05 | -0.32 |
| | (2.32) | (2.14) | (2.00) | (1.21) | (1.11) | (1.08) | (1.11) | (1.12) | (1.07) | (1.10) | (1.10) | (1.24) | (1.28) | (1.43) | (1.32) | (1.30) | (1.26) | (1.29) | (1.24) |
| MR_EU | -1.12* | -0.84 | -1.15* | -0.22 | -0.57 | -0.40 | -0.51 | -0.58 | | | | | | | | | | | |
| | (0.66) | (0.67) | (0.59) | (0.64) | (0.65) | (0.68) | (0.65) | (0.70) | | | | | | | | | | | |
| MR_nonEUrta | 0.07 | -0.23 | 0.16 | 0.79 | 0.61 | 0.98 | 0.94 | 1.24* | 0.30 | 0.47 | 0.21 | | | | | | | | |
| | (0.56) | (0.51) | (0.49) | (0.71) | (0.72) | (0.72) | (0.69) | (0.72) | (1.76) | (1.23) | (1.05) | | | | | | | | |
| MR_landlock_imp | 7.09 | 9.48** | 10.86*** | 8.13** | 7.23** | 9.21*** | 9.43*** | 8.94*** | 9.59*** | 9.47*** | 10.31*** | 11.65*** | 12.07*** | 10.66*** | 11.39*** | 11.29*** | 11.55*** | 10.57*** | 11.72*** |
| | (4.33) | (4.42) | (3.83) | (3.30) | (3.36) | (3.01) | (2.91) | (2.94) | (3.22) | (3.14) | (3.15) | (3.18) | (3.12) | (3.22) | (3.27) | (3.31) | (3.40) | (3.45) | (3.44) |
| MR_landlock_exp | 10.96** | 10.75** | 9.88** | 8.78** | 7.62** | 9.21*** | 7.61** | 8.64** | 8.66** | 8.44** | 8.23** | 9.17** | 9.38** | 10.27** | 11.52*** | 11.43*** | 11.64*** | 11.60*** | 11.55*** |
| | (5.37) | (5.40) | (5.00) | (3.95) | (3.74) | (3.46) | (3.44) | (3.69) | (3.88) | (3.89) | (3.76) | (4.06) | (4.01) | (4.28) | (4.20) | (3.88) | (3.95) | (3.95) | (3.99) |
| MR_comcol | 3.03*** | 2.92*** | 2.65*** | 2.32*** | 2.24*** | 2.49*** | 2.27*** | 2.55*** | 2.46*** | 2.47*** | 2.57*** | 2.63*** | 2.63*** | 2.90*** | 3.00*** | 2.85*** | 3.02*** | 2.90*** | 2.87*** |
| | (0.91) | (0.84) | (0.69) | (0.49) | (0.45) | (0.44) | (0.40) | (0.44) | (0.48) | (0.46) | (0.42) | (0.41) | (0.41) | (0.45) | (0.45) | (0.47) | (0.49) | (0.42) | (0.41) |
| MR_soc_bus_fnd | -0.05 | -0.06 | -0.08 | -0.04 | 0.02 | -0.03 | -0.01 | -0.07 | -0.07 | -0.08 | -0.07 | -0.06 | -0.05 | -0.06 | -0.07 | -0.02 | -0.00 | 0.01 | -0.01 |
| | (0.06) | (0.07) | (0.05) | (0.05) | (0.06) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) | (0.06) | (0.05) | (0.06) |
| MR_gov_fisc_fnd | -0.01 | -0.04 | -0.06 | -0.16*** | -0.13*** | -0.14*** | -0.12*** | -0.14*** | -0.15*** | -0.19*** | -0.17*** | -0.17** | -0.15** | -0.17** | -0.16** | -0.12 | -0.04 | -0.05 | -0.01 |
| | (0.06) | (0.06) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.06) | (0.06) | (0.06) | (0.07) | (0.06) | (0.07) | (0.07) | (0.08) | (0.09) | (0.10) | (0.09) |
| MR_trade_fnd | 0.15 | 0.17 | 0.09 | 0.32** | 0.11 | 0.13 | 0.06 | 0.18 | 0.10 | 0.03 | -0.16 | 0.14 | 0.10 | 0.16 | 0.24 | -0.30 | -0.58** | -0.41 | -0.44 |
| | (0.14) | (0.14) | (0.13) | (0.15) | (0.14) | (0.14) | (0.13) | (0.15) | (0.16) | (0.18) | (0.19) | (0.19) | (0.18) | (0.22) | (0.21) | (0.32) | (0.29) | (0.35) | (0.31) |
| productcode_1 | 1.42*** | 1.41*** | 1.56*** | 1.50*** | 0.54*** | 0.94*** | 1.07*** | 0.66*** | 0.48*** | 0.82*** | 0.73*** | 0.48*** | 0.49*** | 0.49*** | 0.60*** | 1.05*** | 1.19*** | 1.21*** | 1.27*** |
| | (0.22) | (0.19) | (0.18) | (0.18) | (0.16) | (0.15) | (0.14) | (0.16) | (0.13) | (0.09) | (0.11) | (0.12) | (0.12) | (0.12) | (0.13) | (0.13) | (0.13) | (0.12) | (0.12) |
| productcode_2 | -0.34 | -0.30 | -0.14 | -0.15 | -1.11*** | -0.74*** | -0.57*** | -1.01*** | -1.24*** | -0.92*** | -1.04*** | -1.29*** | -1.34*** | -1.33*** | -1.26*** | -0.82*** | -0.70*** | -0.71*** | -0.66*** |
| | (0.23) | (0.21) | (0.21) | (0.20) | (0.18) | (0.16) | (0.15) | (0.17) | (0.15) | (0.12) | (0.17) | (0.16) | (0.17) | (0.16) | (0.17) | (0.13) | (0.14) | (0.13) | (0.13) |
| productcode_3 | 0.33* | 0.40** | 0.51*** | 0.34** | -0.44*** | -0.15 | -0.02 | -0.43*** | -0.54*** | -0.23*** | -0.20* | -0.43*** | -0.53*** | -0.80*** | -0.43*** | 0.09 | 0.16 | 0.09 | 0.14 |
| | (0.20) | (0.18) | (0.16) | (0.17) | (0.16) | (0.14) | (0.14) | (0.17) | (0.13) | (0.09) | (0.11) | (0.11) | (0.11) | (0.11) | (0.13) | (0.12) | (0.13) | (0.12) | (0.11) |
| productcode_4 | 0.43* | 0.50** | 0.39 | 0.46** | 0.04 | 0.30 | 0.36** | -0.04 | -0.09 | 0.46*** | 0.46*** | 0.08 | 0.28* | -0.12 | 0.21 | 0.82*** | 1.00*** | 1.05*** | 0.98*** |
| | (0.26) | (0.25) | (0.24) | (0.23) | (0.22) | (0.18) | (0.17) | (0.20) | (0.16) | (0.11) | (0.11) | (0.15) | (0.15) | (0.15) | (0.17) | (0.19) | (0.19) | (0.21) | (0.20) |
| productcode_5 | -1.56*** | -1.57*** | -1.45*** | -1.59*** | -2.68*** | -2.23*** | -1.96*** | -2.39*** | -2.53*** | -2.19*** | -2.22*** | -2.47*** | -2.23*** | -2.45*** | -2.31*** | -1.69*** | -1.56*** | -1.58*** | -1.62*** |
| | (0.28) | (0.26) | (0.24) | (0.23) | (0.22) | (0.21) | (0.23) | (0.23) | (0.20) | (0.15) | (0.13) | (0.15) | (0.15) | (0.16) | (0.16) | (0.19) | (0.19) | (0.18) | (0.19) |
| productcode_6 | 1.67*** | 1.75*** | 1.95*** | 1.98*** | 1.10*** | 1.52*** | 1.72*** | 1.30*** | 1.16*** | 1.53*** | 1.45*** | 1.19*** | 1.15*** | 1.09*** | 1.25*** | 1.66*** | 1.78*** | 1.76*** | 1.82*** |
| | (0.16) | (0.14) | (0.14) | (0.14) | (0.12) | (0.10) | (0.11) | (0.14) | (0.13) | (0.11) | (0.13) | (0.12) | (0.14) | (0.15) | (0.15) | (0.12) | (0.11) | (0.10) | (0.09) |
| productcode_7 | 2.16*** | 2.23*** | 2.41*** | 2.31*** | 1.43*** | 1.78*** | 1.88*** | 1.44*** | 1.31*** | 1.64*** | 1.61*** | 1.37*** | 1.28*** | 1.00*** | 1.22*** | 1.71*** | 1.75*** | 1.69*** | 1.76*** |
| | (0.16) | (0.14) | (0.13) | (0.14) | (0.13) | (0.11) | (0.10) | (0.13) | (0.11) | (0.09) | (0.13) | (0.11) | (0.13) | (0.13) | (0.14) | (0.09) | (0.10) | (0.09) | (0.08) |
| productcode_8 | 2.91*** | 3.02*** | 3.27*** | 3.19*** | 2.34*** | 2.70*** | 2.81*** | 2.34*** | 2.19*** | 2.51*** | 2.46*** | 2.14*** | 2.04*** | 1.84*** | 2.01*** | 2.44*** | 2.51*** | 2.48*** | 2.60*** |
| | (0.15) | (0.13) | (0.12) | (0.12) | (0.10) | (0.08) | (0.08) | (0.10) | (0.09) | (0.09) | (0.13) | (0.10) | (0.13) | (0.13) | (0.14) | (0.08) | (0.08) | (0.07) | (0.07) |
| productcode_9 | 1.81*** | 1.91*** | 2.05*** | 1.98*** | 1.06*** | 1.46*** | 1.58*** | 1.15*** | 0.95*** | 1.28*** | 1.18*** | 0.89*** | 0.83*** | 0.78*** | 0.90*** | 1.33*** | 1.41*** | 1.41*** | 1.52*** |
| | (0.18) | (0.15) | (0.14) | (0.14) | (0.13) | (0.11) | (0.09) | (0.13) | (0.11) | (0.09) | (0.12) | (0.11) | (0.13) | (0.13) | (0.13) | (0.09) | (0.10) | (0.09) | (0.09) |
| Constant | 11.71 | 8.95 | 2.61 | 18.86 | 26.38** | 16.58 | 17.65 | 10.81 | 5.78 | 4.53 | 3.76 | -5.05 | -2.67 | -1.79 | -4.43 | -0.02 | -0.28 | 1.39 | -5.21 |
| | (17.81) | (18.98) | (17.22) | (13.37) | (12.08) | (11.18) | (11.17) | (13.41) | (13.40) | (13.44) | (12.53) | (13.87) | (13.26) | (13.53) | (14.07) | (12.87) | (13.96) | (14.53) | (14.97) |
| Observations | 6,500 | 6,500 | 6,500 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 | 7,020 |
| R-squared | 0.83 | 0.82 | 0.84 | 0.86 | 0.83 | 0.84 | 0.81 | 0.78 | 0.75 | 0.73 | 0.74 | 0.69 | 0.69 | 0.68 | 0.69 | 0.69 | 0.68 | 0.65 | 0.68 |
| Method | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated | Re-aggregated |

## Table A.3: SITC 0 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.89*** | 0.86*** | 0.83*** | 0.89*** | 0.88*** | 0.88*** | 0.88*** | 0.89*** | 0.86*** | 0.84*** | 0.83*** | 0.81*** | 0.81*** | 0.79*** | 0.78*** | 0.78*** | 0.78*** | 0.78*** | 0.78*** |
| | (0.07) | (0.06) | (0.06) | (0.05) | (0.06) | (0.05) | (0.05) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) | (0.06) |
| ln_expGDPinmil | 0.67*** | 0.67*** | 0.67*** | 0.71*** | 0.69*** | 0.71*** | 0.73*** | 0.74*** | 0.72*** | 0.72*** | 0.71*** | 0.70*** | 0.72*** | 0.71*** | 0.69*** | 0.69*** | 0.69*** | 0.69*** | 0.69*** |
| | (0.07) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| MR_ln_distw | -1.11*** | -1.12*** | -1.15*** | -1.28*** | -1.30*** | -1.22*** | -1.14*** | -1.08*** | -1.06*** | -1.03*** | -1.03*** | -1.05*** | -1.05*** | -1.07*** | -1.04*** | -1.11*** | -1.12*** | -1.12*** | -1.06*** |
| | (0.20) | (0.23) | (0.24) | (0.16) | (0.15) | (0.13) | (0.11) | (0.13) | (0.12) | (0.12) | (0.14) | (0.14) | (0.15) | (0.16) | (0.15) | (0.15) | (0.17) | (0.17) | (0.16) |
| MR_contig | 0.64*** | 0.69*** | 0.54** | 0.31* | 0.37** | 0.37** | 0.42** | 0.51*** | 0.57*** | 0.60*** | 0.65*** | 0.70*** | 0.70*** | 0.65*** | 0.73*** | 0.66*** | 0.68*** | 0.67*** | 0.73*** |
| | (0.22) | (0.23) | (0.24) | (0.17) | (0.18) | (0.18) | (0.17) | (0.19) | (0.19) | (0.18) | (0.20) | (0.21) | (0.22) | (0.21) | (0.21) | (0.23) | (0.24) | (0.24) | (0.25) |
| MR_comlang | -0.44 | -0.49 | -0.41 | 0.43* | 0.33 | 0.30 | 0.37*** | 0.30 | 0.29 | 0.27 | 0.30 | 0.25 | 0.29 | 0.33 | 0.26 | 0.25 | 0.23 | 0.22 | 0.22 |
| | (0.52) | (0.50) | (0.47) | (0.22) | (0.22) | (0.19) | (0.14) | (0.21) | (0.21) | (0.23) | (0.24) | (0.25) | (0.24) | (0.21) | (0.23) | (0.25) | (0.25) | (0.28) | (0.26) |
| MR_west_to_east | -3.60 | -2.81 | -2.19 | -8.80*** | -9.38*** | -7.93*** | -6.49** | -5.21* | -1.86 | -1.22 | -1.57 | -2.11 | -3.88* | -3.22 | -3.35* | -3.11* | -1.75 | -1.27 | -1.62 |
| | (4.18) | (3.99) | (3.87) | (2.72) | (2.73) | (2.63) | (2.60) | (2.80) | (2.65) | (2.23) | (2.18) | (2.08) | (2.10) | (1.96) | (1.93) | (1.81) | (1.78) | (1.98) | (2.01) |
| MR_east_to_west | 2.37 | 1.51 | 0.59 | 6.83** | 7.47*** | 5.77** | 4.52* | 3.14 | 0.47 | 0.43 | 1.25 | 1.76 | 3.71* | 3.30* | 3.37* | 3.29* | 1.81 | 1.45 | 1.89 |
| | (4.19) | (4.02) | (3.92) | (2.71) | (2.69) | (2.59) | (2.59) | (2.80) | (2.55) | (2.15) | (2.11) | (2.03) | (2.02) | (1.94) | (1.90) | (1.82) | (1.79) | (1.91) | (1.93) |
| MR_EU | 1.86* | 1.46 | 1.59** | 1.30* | 1.41** | 1.44* | 0.82 | 0.60 | | | | | | | | | | | |
| | (0.98) | (1.00) | (0.76) | (0.69) | (0.71) | (0.75) | (0.70) | (0.72) | | | | | | | | | | | |
| MR_nonEUrta | 0.79** | 0.57 | 0.90*** | 0.69 | 1.14* | 1.35** | 1.05* | 1.14* | -0.70 | -0.56 | 0.14 | | | | | | | | |
| | (0.35) | (0.40) | (0.35) | (0.66) | (0.64) | (0.65) | (0.57) | (0.59) | (0.72) | (0.84) | (0.72) | | | | | | | | |
| MR_landlock_imp | -9.99** | -8.30* | -9.03* | -9.84** | -13.77*** | -8.27** | -8.35** | -7.86** | -6.64* | -5.47 | -6.22 | -3.71 | -2.57 | -4.06 | -4.43 | -3.63 | -3.53 | -5.09 | -4.60 |
| | (4.72) | (4.68) | (4.90) | (3.90) | (4.27) | (3.87) | (3.63) | (3.74) | (3.61) | (3.64) | (3.79) | (3.91) | (3.90) | (3.76) | (3.84) | (3.98) | (4.11) | (4.06) | (3.90) |
| MR_landlock_exp | 1.90 | 1.29 | -2.28 | 4.22 | -0.58 | 3.92 | 3.73 | 3.03 | 4.85 | 6.68 | 5.82 | 5.06 | 4.20 | 4.42 | 5.10 | 5.68 | 5.27 | 4.49 | 4.43 |
| | (6.82) | (6.89) | (7.56) | (4.91) | (4.49) | (4.63) | (4.37) | (4.55) | (4.45) | (4.55) | (4.22) | (4.27) | (4.25) | (4.09) | (4.07) | (3.98) | (4.05) | (4.09) | (4.16) |
| MR_comcol | 1.17 | 1.05 | 0.97 | 1.29*** | 0.99** | 1.41*** | 1.49*** | 1.47*** | 1.33*** | 1.31*** | 1.55*** | 1.34*** | 1.51*** | 1.71*** | 1.81*** | 1.81*** | 1.89*** | 2.03*** | 1.79*** |
| | (0.86) | (0.83) | (0.66) | (0.43) | (0.46) | (0.47) | (0.45) | (0.47) | (0.40) | (0.41) | (0.41) | (0.42) | (0.40) | (0.41) | (0.42) | (0.42) | (0.41) | (0.39) | (0.39) |
| MR_soc_bus_fnd | -0.09 | -0.07 | -0.09 | -0.02 | 0.07 | -0.03 | -0.07 | -0.07 | -0.05 | -0.03 | 0.01 | 0.02 | 0.00 | 0.01 | 0.00 | 0.00 | 0.05 | 0.06 | 0.05 |
| | (0.08) | (0.09) | (0.07) | (0.09) | (0.10) | (0.07) | (0.05) | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.06) | (0.05) | (0.05) | (0.06) | (0.06) | (0.06) | (0.07) |
| MR_gov_fisc_fnd | -0.09 | -0.13 | -0.15* | -0.25*** | -0.21*** | -0.24*** | -0.25*** | -0.26*** | -0.24*** | -0.26*** | -0.21*** | -0.20*** | -0.19*** | -0.21*** | -0.21*** | -0.19*** | -0.09 | -0.09 | -0.11 |
| | (0.09) | (0.09) | (0.08) | (0.07) | (0.07) | (0.06) | (0.04) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.05) | (0.06) | (0.06) | (0.07) | (0.08) | (0.09) | (0.09) |
| MR_trade_fnd | 0.40* | 0.33 | 0.41** | 0.65*** | 0.46*** | 0.64*** | 0.65*** | 0.50*** | 0.42** | 0.38* | 0.01 | 0.21 | 0.28 | 0.26 | 0.39** | 0.08 | -0.35 | -0.31 | -0.26 |
| | (0.21) | (0.22) | (0.19) | (0.21) | (0.17) | (0.20) | (0.19) | (0.19) | (0.18) | (0.21) | (0.21) | (0.17) | (0.17) | (0.18) | (0.19) | (0.37) | (0.39) | (0.48) | (0.43) |
| Constant | 51.18*** | 53.08** | 60.30*** | 66.01*** | 80.24*** | 58.64*** | 58.35*** | 55.80*** | 55.08*** | 48.19*** | 48.59*** | 48.49*** | 47.63*** | 51.62*** | 50.20*** | 50.44*** | 49.11*** | 52.86*** | 49.06*** |
| | (18.26) | (21.07) | (19.78) | (13.32) | (11.52) | (11.39) | (10.90) | (12.71) | (11.56) | (13.20) | (12.65) | (13.51) | (14.18) | (13.77) | (14.13) | (13.14) | (13.88) | (14.24) | (14.80) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.78 | 0.76 | 0.79 | 0.85 | 0.84 | 0.85 | 0.87 | 0.83 | 0.82 | 0.82 | 0.80 | 0.79 | 0.79 | 0.79 | 0.79 | 0.76 | 0.75 | 0.73 | 0.73 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table A.4: SITC 1 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.86*** | 0.86*** | 0.84*** | 0.80*** | 0.77*** | 0.82*** | 0.80*** | 0.81*** | 0.83*** | 0.83*** | 0.82*** | 0.79*** | 0.76*** | 0.77*** | 0.75*** | 0.77*** | 0.75*** | 0.74*** | 0.73*** |
| | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.06) | (0.06) | (0.07) | (0.05) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| ln_expGDPinmil | 0.80*** | 0.80*** | 0.82*** | 0.89*** | 0.86*** | 0.93*** | 0.91*** | 0.92*** | 0.93*** | 0.93*** | 0.93*** | 0.91*** | 0.94*** | 0.90*** | 0.90*** | 0.88*** | 0.87*** | 0.85*** | 0.85*** |
| | (0.07) | (0.07) | (0.07) | (0.08) | (0.07) | (0.07) | (0.08) | (0.07) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) |
| MR_ln_distw | -1.25*** | -1.49*** | -1.55*** | -1.73*** | -1.57*** | -1.50*** | -1.41*** | -1.44*** | -1.31*** | -1.17*** | -1.29*** | -1.35*** | -1.40*** | -1.34*** | -1.16*** | -1.22*** | -1.23*** | -1.26*** | -1.15*** |
| | (0.30) | (0.26) | (0.32) | (0.25) | (0.25) | (0.21) | (0.22) | (0.21) | (0.19) | (0.21) | (0.19) | (0.15) | (0.16) | (0.19) | (0.20) | (0.18) | (0.18) | (0.17) | (0.16) |
| MR_contig | -0.50* | -0.54** | -0.68** | -0.68** | -0.51 | -0.55* | -0.41 | -0.27 | -0.24 | -0.15 | -0.17 | -0.23 | -0.28 | -0.27 | -0.14 | -0.26 | -0.25 | -0.16 | -0.01 |
| | (0.29) | (0.27) | (0.35) | (0.32) | (0.35) | (0.29) | (0.28) | (0.31) | (0.27) | (0.28) | (0.28) | (0.24) | (0.24) | (0.24) | (0.23) | (0.29) | (0.29) | (0.27) | (0.25) |
| MR_comlang | -0.05 | -0.03 | 0.16 | 0.95*** | 0.91*** | 0.87*** | 0.70** | 0.79*** | 0.97*** | 0.91*** | 0.97*** | 1.03*** | 0.97*** | 0.89*** | 0.83*** | 0.81*** | 0.78** | 0.68** | 0.62** |
| | (0.59) | (0.57) | (0.64) | (0.31) | (0.31) | (0.25) | (0.31) | (0.24) | (0.23) | (0.25) | (0.26) | (0.26) | (0.26) | (0.26) | (0.26) | (0.30) | (0.30) | (0.29) | (0.29) |
| MR_west_to_east | -4.90 | -2.93 | -2.77 | -9.43** | -8.75*** | -8.87*** | -7.65** | -10.62*** | -11.02*** | -13.34*** | -10.70*** | -6.88** | -1.14 | 4.49 | 4.77 | 2.79 | 2.40 | 4.04 | 7.47* |
| | (4.56) | (5.06) | (5.19) | (3.69) | (3.34) | (3.26) | (3.78) | (3.22) | (2.78) | (2.72) | (2.99) | (3.09) | (3.38) | (3.66) | (3.61) | (3.25) | (3.55) | (3.40) | (3.98) |
| MR_east_to_west | 3.23 | 0.62 | 0.11 | 6.73* | 6.46** | 6.10** | 5.02 | 8.45*** | 7.58*** | 9.95*** | 8.34*** | 4.85* | -0.16 | -5.34 | -5.43 | -3.29 | -2.80 | -4.36 | -7.54** |
| | (4.80) | (5.18) | (5.20) | (3.49) | (3.28) | (3.04) | (3.74) | (3.07) | (2.69) | (2.63) | (2.90) | (2.91) | (3.13) | (3.42) | (3.38) | (3.05) | (3.34) | (3.17) | (3.67) |
| MR_EU | -1.56 | -1.10 | -0.11 | -0.63 | -0.13 | 0.43 | 0.78 | 0.73 | | | | | | | | | | | |
| | (1.13) | (1.19) | (1.01) | (1.17) | (1.30) | (1.03) | (0.99) | (0.96) | | | | | | | | | | | |
| MR_nonEUrta | -0.59 | -0.57 | -0.04 | -1.17 | -1.01 | -0.68 | 0.05 | -0.11 | -0.36 | -1.10 | 0.06 | | | | | | | | |
| | (0.72) | (0.58) | (0.58) | (0.88) | (0.79) | (0.82) | (0.97) | (0.86) | (2.36) | (1.99) | (1.24) | | | | | | | | |
| MR_landlock_imp | -10.11 | -5.73 | -0.98 | 9.48 | 8.14 | 12.86** | 11.25 | 13.15** | 14.12*** | 13.54** | 7.36 | 6.38 | 6.14 | 1.12 | 1.54 | -0.65 | -3.02 | -4.43 | -5.06 |
| | (10.85) | (11.28) | (9.64) | (6.53) | (7.13) | (6.53) | (7.33) | (5.97) | (5.45) | (5.47) | (5.76) | (5.66) | (5.22) | (6.21) | (6.26) | (5.79) | (5.64) | (5.57) | (6.11) |
| MR_landlock_exp | -13.26 | -8.02 | -8.16 | 1.09 | -0.95 | 1.42 | 1.97 | 2.89 | 1.43 | 2.69 | -0.23 | -1.14 | -3.03 | 0.56 | 0.08 | -1.99 | -2.63 | -1.35 | -0.81 |
| | (9.52) | (9.45) | (8.31) | (6.80) | (6.42) | (5.49) | (5.13) | (4.93) | (4.80) | (4.65) | (4.35) | (5.00) | (4.58) | (4.58) | (4.59) | (4.78) | (4.89) | (4.76) | (4.78) |
| MR_comcol | 1.21 | 1.95* | 2.58*** | 2.94*** | 2.51*** | 3.13*** | 2.78*** | 2.56*** | 2.52*** | 2.38*** | 2.42*** | 2.67*** | 2.22*** | 2.44*** | 2.68*** | 2.60*** | 2.40*** | 2.27*** | 2.36*** |
| | (1.89) | (1.11) | (0.80) | (0.62) | (0.57) | (0.53) | (0.63) | (0.57) | (0.57) | (0.61) | (0.56) | (0.53) | (0.56) | (0.62) | (0.65) | (0.62) | (0.60) | (0.60) | (0.65) |
| MR_soc_bus_fnd | 0.24** | 0.29* | 0.35*** | 0.37** | 0.52*** | 0.35*** | 0.30*** | 0.32*** | 0.29*** | 0.28*** | 0.28*** | 0.27*** | 0.25*** | 0.19*** | 0.12** | 0.16** | 0.20*** | 0.20*** | 0.14 |
| | (0.12) | (0.15) | (0.11) | (0.15) | (0.13) | (0.10) | (0.10) | (0.07) | (0.05) | (0.07) | (0.06) | (0.05) | (0.05) | (0.06) | (0.06) | (0.07) | (0.07) | (0.07) | (0.09) |
| MR_gov_fisc_fnd | -0.05 | -0.15 | -0.12 | -0.12 | -0.01 | -0.18** | -0.22*** | -0.19** | -0.18** | -0.20** | -0.17* | -0.15* | -0.20*** | -0.17** | -0.16* | -0.06 | -0.04 | -0.03 | -0.02 |
| | (0.13) | (0.14) | (0.14) | (0.10) | (0.09) | (0.08) | (0.08) | (0.08) | (0.08) | (0.09) | (0.09) | (0.08) | (0.07) | (0.09) | (0.09) | (0.11) | (0.11) | (0.12) | (0.13) |
| MR_trade_fnd | -0.31 | -0.10 | 0.15 | 0.53** | 0.29 | 0.88*** | 0.77*** | 0.57** | 0.52** | 0.60* | 0.15 | -0.05 | 0.20 | 0.38 | 0.92*** | -0.07 | -0.37 | -0.31 | -0.13 |
| | (0.32) | (0.33) | (0.18) | (0.25) | (0.23) | (0.32) | (0.25) | (0.23) | (0.26) | (0.33) | (0.26) | (0.21) | (0.25) | (0.30) | (0.26) | (0.39) | (0.42) | (0.39) | (0.45) |
| Constant | 94.85*** | 93.87*** | 85.97*** | 81.00*** | 76.15*** | 54.11*** | 49.00*** | 46.40*** | 41.99*** | 34.24** | 52.54*** | 58.27*** | 64.66*** | 64.85*** | 56.32*** | 61.48*** | 66.00*** | 68.53*** | 62.40*** |
| | (28.97) | (29.77) | (27.98) | (18.89) | (18.31) | (16.08) | (17.74) | (16.01) | (13.47) | (15.11) | (14.67) | (14.38) | (13.81) | (16.71) | (17.95) | (15.06) | (14.00) | (13.61) | (14.86) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.64 | 0.64 | 0.65 | 0.67 | 0.66 | 0.70 | 0.68 | 0.69 | 0.70 | 0.68 | 0.70 | 0.72 | 0.74 | 0.73 | 0.75 | 0.71 | 0.72 | 0.73 | 0.72 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Table A.5: SITC 2 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.90*** | 0.87*** | 0.87*** | 0.86*** | 0.85*** | 0.83*** | 0.82*** | 0.84*** | 0.81*** | 0.79*** | 0.77*** | 0.75*** | 0.77*** | 0.77*** | 0.73*** | 0.74*** | 0.75*** | 0.76*** | 0.75*** |
| | (0.07) | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) | (0.06) | (0.07) | (0.06) |
| ln_expGDPinmil | 0.44*** | 0.41*** | 0.44*** | 0.58*** | 0.51*** | 0.54*** | 0.55*** | 0.54*** | 0.56*** | 0.56*** | 0.58*** | 0.59*** | 0.63*** | 0.57*** | 0.57*** | 0.61*** | 0.60*** | 0.57*** | 0.59*** |
| | (0.07) | (0.07) | (0.08) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| MR_ln_distw | -0.75*** | -0.82*** | -0.71** | -1.00*** | -0.99*** | -1.00*** | -0.94*** | -0.82*** | -0.82*** | -0.77*** | -0.67*** | -0.61*** | -0.68*** | -0.82*** | -0.75*** | -0.82*** | -0.81*** | -0.77*** | -0.69*** |
| | (0.24) | (0.27) | (0.28) | (0.18) | (0.18) | (0.16) | (0.15) | (0.18) | (0.16) | (0.17) | (0.18) | (0.19) | (0.17) | (0.20) | (0.17) | (0.19) | (0.21) | (0.23) | (0.22) |
| MR_contig | 0.66** | 0.74*** | 0.69*** | 0.56** | 0.47** | 0.41** | 0.60*** | 0.73*** | 0.78*** | 0.76*** | 0.84*** | 0.97*** | 0.98*** | 0.90*** | 0.94*** | 0.90*** | 0.91*** | 0.97*** | 1.02*** |
| | (0.26) | (0.26) | (0.27) | (0.22) | (0.23) | (0.19) | (0.19) | (0.22) | (0.23) | (0.24) | (0.25) | (0.26) | (0.24) | (0.27) | (0.23) | (0.26) | (0.27) | (0.28) | (0.28) |
| MR_comlang | -0.74 | -0.81 | -0.80 | 0.10 | 0.05 | -0.04 | -0.08 | -0.10 | 0.02 | 0.08 | 0.23 | 0.21 | 0.29 | 0.20 | 0.31 | 0.27 | 0.22 | 0.20 | 0.22 |
| | (0.51) | (0.57) | (0.53) | (0.25) | (0.25) | (0.23) | (0.23) | (0.29) | (0.29) | (0.31) | (0.31) | (0.31) | (0.29) | (0.30) | (0.27) | (0.29) | (0.33) | (0.39) | (0.34) |
| MR_west_to_east | -2.35 | -0.46 | -0.19 | 2.08 | 0.59 | 0.64 | 1.77 | 1.04 | 4.02 | 3.93 | 4.64* | 4.67* | 5.20** | 2.93 | 4.96** | 3.68 | 2.43 | 2.50 | 1.95 |
| | (4.20) | (4.04) | (3.79) | (3.07) | (2.87) | (2.81) | (3.27) | (3.21) | (3.09) | (2.79) | (2.58) | (2.54) | (2.50) | (2.53) | (2.23) | (2.63) | (2.59) | (2.77) | (2.64) |
| MR_east_to_west | 3.49 | 1.99 | 1.50 | -1.28 | 0.35 | 0.14 | -0.54 | 0.28 | -3.90 | -3.50 | -3.89 | -3.98 | -4.52* | -2.07 | -4.24* | -2.70 | -1.64 | -1.65 | -0.99 |
| | (4.27) | (4.09) | (3.83) | (3.07) | (2.90) | (2.82) | (3.22) | (3.23) | (3.00) | (2.74) | (2.58) | (2.56) | (2.53) | (2.60) | (2.30) | (2.78) | (2.74) | (2.88) | (2.71) |
| MR_EU | 1.80*** | 1.63*** | 2.41*** | 2.66*** | 3.05*** | 3.36*** | 2.90*** | 3.45*** | | | | | | | | | | | |
| | (0.66) | (0.60) | (0.60) | (0.91) | (0.97) | (1.06) | (1.02) | (1.04) | | | | | | | | | | | |
| MR_nonEUrta | 0.22 | 0.01 | 0.60 | 1.44 | 1.91** | 2.18** | 2.09** | 2.33** | -0.71 | -0.08 | 0.22 | | | | | | | | |
| | (0.34) | (0.36) | (0.41) | (0.91) | (0.91) | (0.96) | (0.92) | (0.93) | (0.70) | (0.73) | (0.53) | | | | | | | | |
| MR_landlock_imp | 3.34 | 1.00 | 3.89 | 3.30 | -5.12 | -1.06 | -0.38 | -3.06 | -1.33 | -2.36 | -3.86 | -1.14 | 2.11 | 2.68 | 1.43 | 0.67 | 2.32 | -1.01 | -1.73 |
| | (4.99) | (4.95) | (5.72) | (6.99) | (6.47) | (6.21) | (6.00) | (6.33) | (5.77) | (5.54) | (5.49) | (5.04) | (4.39) | (4.36) | (3.95) | (3.97) | (4.03) | (3.94) | (4.07) |
| MR_landlock_exp | 13.32* | 11.38 | 13.72* | 15.67*** | 12.32** | 14.32*** | 14.61*** | 12.58** | 12.55*** | 11.54** | 10.72** | 9.23* | 11.25** | 13.17*** | 13.37*** | 11.57** | 12.33*** | 11.69** | 9.93** |
| | (7.67) | (8.29) | (7.47) | (6.00) | (5.25) | (5.04) | (5.21) | (5.04) | (4.82) | (5.03) | (4.83) | (4.83) | (4.68) | (4.82) | (4.40) | (4.54) | (4.49) | (4.66) | (4.61) |
| MR_comcol | -1.79 | -2.73 | -5.05 | -9.14 | -2.61 | -0.70 | -0.32 | 0.09 | -0.18 | 0.13 | 0.73 | 1.08** | 1.33*** | 0.93* | 1.38*** | 1.47*** | 1.64*** | 1.74*** | 1.78*** |
| | (3.02) | (3.77) | (5.79) | (6.00) | (3.93) | (2.30) | (1.69) | (1.43) | (0.97) | (0.83) | (0.53) | (0.46) | (0.47) | (0.51) | (0.48) | (0.47) | (0.44) | (0.39) | (0.42) |
| MR_soc_bus_fnd | 0.01 | -0.02 | -0.14* | -0.06 | 0.03 | -0.06 | -0.10 | -0.20*** | -0.18** | -0.17** | -0.13* | -0.11* | -0.10 | -0.07 | -0.08 | -0.07 | -0.05 | -0.04 | -0.05 |
| | (0.09) | (0.09) | (0.08) | (0.10) | (0.11) | (0.09) | (0.08) | (0.07) | (0.07) | (0.08) | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.09) | (0.08) | (0.08) | (0.08) |
| MR_gov_fisc_fnd | -0.24*** | -0.25*** | -0.26*** | -0.32*** | -0.30*** | -0.32*** | -0.31*** | -0.30*** | -0.34*** | -0.37*** | -0.34*** | -0.33*** | -0.29*** | -0.34*** | -0.30*** | -0.21** | -0.16 | -0.13 | -0.12 |
| | (0.09) | (0.08) | (0.08) | (0.07) | (0.08) | (0.06) | (0.05) | (0.06) | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.08) | (0.08) | (0.10) | (0.11) | (0.10) |
| MR_trade_fnd | 0.03 | -0.03 | 0.12 | 0.43** | 0.20 | 0.41** | 0.18 | 0.38 | 0.30 | 0.19 | -0.17 | 0.12 | 0.20 | 0.21 | 0.12 | -0.49 | -0.66 | -0.37 | -0.63 |
| | (0.17) | (0.15) | (0.16) | (0.20) | (0.18) | (0.21) | (0.21) | (0.23) | (0.22) | (0.26) | (0.22) | (0.18) | (0.20) | (0.28) | (0.30) | (0.43) | (0.45) | (0.58) | (0.48) |
| Constant | 0.44 | 11.77 | -6.01 | 1.13 | 17.83 | 5.83 | 2.81 | 0.47 | 18.36 | 18.64 | 14.33 | 9.67 | 5.11 | 10.17 | 7.78 | 11.29 | 6.57 | 12.23 | 9.65 |
| | (19.29) | (23.32) | (22.17) | (17.84) | (15.19) | (15.86) | (14.06) | (16.90) | (13.11) | (14.97) | (14.29) | (14.22) | (12.88) | (14.64) | (12.90) | (12.97) | (14.81) | (16.48) | (17.64) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.66 | 0.65 | 0.68 | 0.74 | 0.70 | 0.73 | 0.73 | 0.68 | 0.67 | 0.66 | 0.65 | 0.66 | 0.67 | 0.65 | 0.67 | 0.66 | 0.63 | 0.58 | 0.60 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

## Table A.6: SITC 3 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.95*** | 0.92*** | 0.97*** | 1.00*** | 0.96*** | 0.98*** | 0.89*** | 0.90*** | 0.80*** | 0.85*** | 0.87*** | 0.78*** | 0.81*** | 0.77*** | 0.77*** | 0.77*** | 0.75*** | 0.89*** | 0.82*** |
| | (0.19) | (0.20) | (0.20) | (0.15) | (0.14) | (0.14) | (0.11) | (0.12) | (0.11) | (0.11) | (0.11) | (0.09) | (0.09) | (0.09) | (0.09) | (0.10) | (0.12) | (0.17) | (0.15) |
| ln_expGDPinmil | 0.73*** | 0.78*** | 0.85*** | 0.94*** | 0.91*** | 0.96*** | 0.95*** | 0.94*** | 0.79*** | 0.81*** | 0.86*** | 0.85*** | 0.80*** | 0.79*** | 0.77*** | 0.72*** | 0.70*** | 0.67*** | 0.70*** |
| | (0.14) | (0.16) | (0.14) | (0.11) | (0.10) | (0.11) | (0.11) | (0.10) | (0.09) | (0.09) | (0.10) | (0.09) | (0.08) | (0.10) | (0.10) | (0.08) | (0.08) | (0.08) | (0.08) |
| MR_ln_distw | -2.15*** | -2.27*** | -2.10*** | -2.52*** | -2.65*** | -2.60*** | -2.56*** | -2.40*** | -2.16*** | -2.01*** | -1.99*** | -1.92*** | -1.85*** | -1.90*** | -1.89*** | -2.05*** | -1.87*** | -1.96*** | -1.86*** |
| | (0.32) | (0.32) | (0.39) | (0.23) | (0.24) | (0.24) | (0.24) | (0.25) | (0.22) | (0.20) | (0.22) | (0.23) | (0.27) | (0.28) | (0.28) | (0.26) | (0.26) | (0.30) | (0.29) |
| MR_contig | 0.00 | 0.17 | 0.13 | -0.32 | -0.49* | -0.56** | -0.39 | -0.34 | -0.14 | 0.14 | 0.04 | 0.19 | 0.13 | 0.08 | 0.12 | 0.16 | 0.43 | 0.52 | 0.60 |
| | (0.24) | (0.37) | (0.31) | (0.25) | (0.26) | (0.27) | (0.28) | (0.27) | (0.33) | (0.28) | (0.31) | (0.32) | (0.30) | (0.30) | (0.31) | (0.31) | (0.32) | (0.38) | (0.39) |
| MR_comlang | -1.10 | -1.44* | -1.20* | -0.37 | -0.35 | -0.23 | -0.01 | 0.23 | 0.25 | 0.20 | 0.36 | 0.07 | 0.27 | 0.42 | 0.32 | 0.22 | 0.29 | -0.04 | -0.10 |
| | (0.73) | (0.76) | (0.66) | (0.35) | (0.42) | (0.45) | (0.39) | (0.47) | (0.48) | (0.42) | (0.42) | (0.40) | (0.35) | (0.32) | (0.35) | (0.38) | (0.43) | (0.58) | (0.47) |
| MR_west_to_east | 2.43 | 3.23 | 5.57 | 1.64 | 3.68 | 10.62* | 15.62*** | 10.61** | 18.01*** | 13.43*** | 7.11* | 5.08 | 6.15 | 7.28 | 9.74** | 7.20* | 7.45* | 3.49 | 2.03 |
| | (10.31) | (10.02) | (8.86) | (6.20) | (6.22) | (5.62) | (4.86) | (4.78) | (4.89) | (4.36) | (3.90) | (4.25) | (4.42) | (4.65) | (4.25) | (4.11) | (4.33) | (4.65) | (4.90) |
| MR_east_to_west | -8.03 | -8.06 | -11.42 | -7.65 | -9.10 | -15.94*** | -19.78*** | -14.91*** | -18.17*** | -13.10*** | -6.51 | -4.51 | -5.53 | -6.54 | -9.33** | -6.84 | -6.65 | -2.68 | -0.95 |
| | (10.58) | (10.13) | (8.83) | (6.01) | (6.07) | (5.53) | (4.70) | (4.75) | (4.88) | (4.48) | (4.17) | (4.42) | (4.59) | (4.80) | (4.41) | (4.34) | (4.47) | (4.79) | (5.00) |
| MR_EU | -3.03*** | -3.77*** | -4.94*** | -2.93*** | -2.74** | -2.94 | -1.86 | -2.28* | | | | | | | | | | | |
| | (1.16) | (1.20) | (1.01) | (1.05) | (1.12) | (1.81) | (1.84) | (1.32) | | | | | | | | | | | |
| MR_nonEUrta | 1.62** | 1.17** | 1.30** | 3.24** | 2.29* | 2.41 | 2.60 | 1.41 | -0.14 | 0.51 | -0.62 | | | | | | | | |
| | (0.65) | (0.59) | (0.57) | (1.32) | (1.36) | (2.00) | (1.72) | (1.18) | (0.91) | (0.91) | (0.68) | | | | | | | | |
| MR_landlock_imp | -0.57 | 1.01 | 6.60 | 2.28 | -2.65 | 4.23 | 7.34 | 7.40 | 6.02 | 7.81 | 10.37 | 6.96 | 1.29 | 8.01 | 5.17 | 0.82 | 1.45 | -6.33 | -3.98 |
| | (7.04) | (8.90) | (7.25) | (7.46) | (7.64) | (7.57) | (7.63) | (8.32) | (8.48) | (8.33) | (8.52) | (7.32) | (7.02) | (7.19) | (7.14) | (6.95) | (6.83) | (7.32) | (7.43) |
| MR_landlock_exp | 15.15 | 13.61 | 22.34** | 22.16*** | 18.51** | 23.56*** | 19.57*** | 20.65*** | 22.67*** | 23.29*** | 22.28*** | 21.87*** | 21.60*** | 21.65*** | 21.86*** | 18.91*** | 17.63** | 19.80** | 16.56** |
| | (9.97) | (8.98) | (9.31) | (8.49) | (9.08) | (8.21) | (6.18) | (7.21) | (6.78) | (6.64) | (6.88) | (8.25) | (7.71) | (6.95) | (7.05) | (7.05) | (7.12) | (8.67) | (8.07) |
| MR_comcol | 1.33 | 0.97 | 2.58*** | 2.65*** | 2.30*** | 3.22*** | 2.28*** | 2.55*** | 1.85** | 1.68* | 2.24** | 1.82** | 1.82** | 2.34** | 2.06** | 1.89** | 2.10** | 1.97** | 1.29* |
| | (1.14) | (1.09) | (0.88) | (0.85) | (0.74) | (0.88) | (0.87) | (0.77) | (0.84) | (0.87) | (0.90) | (0.75) | (0.73) | (0.93) | (0.86) | (0.91) | (0.94) | (0.87) | (0.71) |
| MR_soc_bus_fnd | -0.29** | -0.26** | -0.26** | -0.24* | -0.27* | -0.26* | -0.14 | -0.16 | -0.11 | -0.07 | -0.16* | -0.21** | -0.26*** | -0.28** | -0.29** | -0.21 | -0.28** | -0.19 | -0.21 |
| | (0.11) | (0.13) | (0.12) | (0.13) | (0.15) | (0.14) | (0.13) | (0.11) | (0.11) | (0.10) | (0.09) | (0.09) | (0.09) | (0.11) | (0.12) | (0.14) | (0.12) | (0.15) | (0.14) |
| MR_gov_fisc_fnd | -0.32*** | -0.27** | -0.38*** | -0.45*** | -0.42*** | -0.31*** | -0.26*** | -0.32*** | -0.34*** | -0.45*** | -0.41*** | -0.40*** | -0.36*** | -0.36*** | -0.33*** | -0.29*** | -0.43*** | -0.38*** | -0.38*** |
| | (0.11) | (0.13) | (0.12) | (0.11) | (0.10) | (0.10) | (0.08) | (0.10) | (0.08) | (0.08) | (0.08) | (0.07) | (0.06) | (0.07) | (0.09) | (0.10) | (0.12) | (0.13) | (0.13) |
| MR_trade_fnd | 0.39 | 0.15 | -0.09 | 0.01 | 0.18 | -0.01 | -0.14 | 0.16 | -0.16 | -0.29 | -0.56 | -0.04 | 0.10 | -0.10 | 0.12 | 0.14 | 0.57 | -0.17 | -0.41 |
| | (0.24) | (0.22) | (0.18) | (0.24) | (0.23) | (0.25) | (0.24) | (0.39) | (0.37) | (0.35) | (0.34) | (0.20) | (0.24) | (0.25) | (0.28) | (0.62) | (0.75) | (1.08) | (0.96) |
| Constant | 97.93*** | 107.19*** | 81.94*** | 102.42*** | 126.01*** | 104.37*** | 98.49*** | 92.26*** | 70.90*** | 55.18** | 49.38* | 53.70** | 60.06** | 50.90** | 56.97** | 78.95*** | 70.20*** | 79.78*** | 74.06*** |
| | (27.10) | (28.39) | (29.66) | (22.18) | (21.38) | (21.49) | (21.90) | (26.10) | (25.89) | (24.59) | (26.04) | (24.61) | (24.41) | (24.25) | (25.79) | (24.17) | (24.64) | (27.26) | (27.63) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.57 | 0.46 | 0.50 | 0.58 | 0.55 | 0.54 | 0.57 | 0.56 | 0.56 | 0.60 | 0.62 | 0.63 | 0.65 | 0.62 | 0.60 | 0.58 | 0.59 | 0.49 | 0.52 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Table A.7: SITC 4 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.92*** | 0.85*** | 0.75*** | 0.82*** | 0.92*** | 0.94*** | 0.95*** | 0.96*** | 0.97*** | 0.95*** | 0.93*** | 0.96*** | 0.90*** | 0.87*** | 0.81*** | 0.79*** | 0.78*** | 0.74*** | 0.71*** |
| | (0.15) | (0.15) | (0.09) | (0.09) | (0.10) | (0.12) | (0.13) | (0.12) | (0.13) | (0.11) | (0.09) | (0.11) | (0.11) | (0.11) | (0.10) | (0.11) | (0.11) | (0.10) | (0.09) |
| ln_expGDPinmil | 0.68*** | 0.67*** | 0.67*** | 0.69*** | 0.76*** | 0.81*** | 0.89*** | 0.85*** | 0.85*** | 0.78*** | 0.71*** | 0.74*** | 0.72*** | 0.75*** | 0.73*** | 0.74*** | 0.72*** | 0.65*** | 0.67*** |
| | (0.12) | (0.11) | (0.11) | (0.15) | (0.10) | (0.10) | (0.07) | (0.10) | (0.08) | (0.10) | (0.09) | (0.09) | (0.08) | (0.08) | (0.07) | (0.07) | (0.07) | (0.07) | (0.06) |
| MR_ln_distw | -1.82*** | -1.52*** | -1.64*** | -1.79*** | -1.99*** | -2.01*** | -2.03*** | -1.93*** | -1.72*** | -1.72*** | -1.64*** | -1.69*** | -1.66*** | -1.80*** | -1.86*** | -1.87*** | -1.78*** | -1.59*** | -1.53*** |
| | (0.33) | (0.30) | (0.26) | (0.21) | (0.20) | (0.20) | (0.22) | (0.24) | (0.20) | (0.22) | (0.22) | (0.23) | (0.25) | (0.26) | (0.29) | (0.26) | (0.28) | (0.29) | (0.27) |
| MR_contig | 0.46 | 0.53 | 0.36 | 0.05 | -0.04 | -0.09 | -0.39 | -0.08 | 0.15 | 0.12 | 0.52 | 0.51 | 0.60 | 0.30 | 0.40 | 0.38 | 0.50 | 0.64 | 0.70 |
| | (0.37) | (0.44) | (0.40) | (0.30) | (0.31) | (0.31) | (0.46) | (0.40) | (0.41) | (0.46) | (0.37) | (0.42) | (0.38) | (0.38) | (0.44) | (0.41) | (0.41) | (0.41) | (0.46) |
| MR_comlang | -0.89* | -0.90 | -1.41** | -0.12 | -0.05 | -0.13 | 0.29 | -0.29 | -0.16 | -0.36 | -0.52 | -0.60 | -0.41 | -0.12 | -0.21 | -0.20 | -0.44 | -0.48 | -0.42 |
| | (0.51) | (0.61) | (0.57) | (0.35) | (0.34) | (0.36) | (0.49) | (0.36) | (0.36) | (0.34) | (0.47) | (0.50) | (0.43) | (0.36) | (0.37) | (0.37) | (0.42) | (0.47) | (0.47) |
| MR_west_to_east | -16.70** | -17.09** | -16.33*** | -27.21*** | -36.75*** | -40.18*** | -39.60*** | -36.51*** | -32.86*** | -19.08*** | -13.24** | -8.14 | -18.10*** | -12.18*** | -8.86* | -11.54*** | -10.55** | -5.55 | -3.13 |
| | (7.72) | (6.71) | (5.83) | (6.08) | (5.55) | (6.57) | (6.48) | (6.19) | (5.61) | (5.20) | (5.94) | (5.63) | (5.25) | (4.41) | (4.58) | (3.89) | (4.72) | (4.93) | (4.40) |
| MR_east_to_west | 15.96** | 15.96** | 14.36** | 25.00*** | 33.01*** | 35.26*** | 35.76*** | 33.08*** | 29.55*** | 17.55*** | 13.40** | 8.56 | 17.91*** | 11.80*** | 8.57** | 11.24*** | 9.66** | 5.16 | 2.87 |
| | (7.95) | (7.09) | (5.82) | (6.27) | (5.31) | (6.06) | (5.52) | (5.60) | (4.92) | (4.60) | (5.47) | (5.39) | (4.93) | (4.20) | (4.22) | (3.78) | (4.77) | (4.91) | (4.42) |
| MR_EU | 6.10** | 5.67** | 2.45* | 4.06*** | 4.28*** | 4.76*** | 2.44* | 2.42** | | | | | | | | | | | |
| | (2.58) | (2.82) | (1.33) | (1.18) | (1.47) | (1.52) | (1.30) | (1.15) | | | | | | | | | | | |
| MR_nonEUrta | 1.06** | 1.32 | 1.54*** | 2.31** | 3.53*** | 4.27*** | 2.60** | 3.26*** | -1.45 | -2.77 | 0.52 | | | | | | | | |
| | (0.51) | (1.49) | (0.58) | (1.17) | (1.27) | (1.48) | (1.22) | (1.15) | (2.05) | (1.80) | (0.93) | | | | | | | | |
| MR_landlock_imp | -22.52*** | -14.61* | -22.52** | -24.79** | -27.47** | -21.13** | -20.07*** | -19.13** | -12.23 | -12.15 | -18.31** | -14.30* | -11.73 | -3.57 | -1.91 | 1.12 | 7.46 | 5.11 | 3.39 |
| | (7.53) | (7.85) | (11.17) | (10.02) | (11.15) | (8.72) | (7.15) | (7.47) | (8.50) | (8.71) | (8.90) | (8.40) | (8.02) | (8.50) | (6.76) | (6.52) | (6.61) | (6.01) | (5.88) |
| MR_landlock_exp | -2.33 | -3.77 | -11.23 | -4.91 | -8.58 | 0.89 | -0.48 | -0.06 | 4.26 | 1.99 | -0.32 | 4.75 | 3.35 | 10.81 | 10.53** | 10.37** | 12.36** | 6.39 | 1.81 |
| | (10.78) | (9.64) | (11.25) | (8.32) | (7.65) | (6.58) | (7.75) | (7.25) | (7.12) | (6.68) | (6.10) | (5.68) | (6.32) | (6.80) | (5.24) | (5.29) | (6.13) | (5.12) | (4.59) |
| MR_comcol | -2.23 | -5.32 | -4.79 | -5.07 | 0.06 | 0.77 | 1.48 | 1.58 | 1.39 | 1.55* | 1.59* | 1.59** | 0.96 | 1.19 | 1.45** | 0.66 | 0.69 | 0.77 | 0.61 |
| | (5.69) | (7.09) | (6.37) | (6.72) | (0.83) | (0.83) | (1.16) | (0.97) | (0.89) | (0.89) | (0.82) | (0.69) | (0.74) | (0.77) | (0.72) | (0.67) | (0.69) | (0.64) | (0.60) |
| MR_soc_bus_fnd | -0.29** | -0.38*** | -0.37*** | -0.26* | -0.03 | -0.18 | -0.30** | -0.23** | -0.18 | -0.16 | -0.02 | -0.05 | -0.10 | -0.07 | 0.03 | 0.06 | 0.03 | 0.07 | -0.03 |
| | (0.12) | (0.14) | (0.10) | (0.13) | (0.18) | (0.16) | (0.13) | (0.11) | (0.13) | (0.15) | (0.10) | (0.09) | (0.11) | (0.10) | (0.10) | (0.13) | (0.13) | (0.11) | (0.11) |
| MR_gov_fisc_fnd | 0.07 | -0.02 | -0.27** | -0.37*** | -0.39*** | -0.40*** | -0.34*** | -0.39*** | -0.34*** | -0.39*** | -0.36*** | -0.42*** | -0.35*** | -0.40*** | -0.34*** | -0.36*** | -0.17 | -0.21 | -0.20 |
| | (0.17) | (0.15) | (0.11) | (0.11) | (0.09) | (0.07) | (0.08) | (0.09) | (0.10) | (0.10) | (0.12) | (0.10) | (0.10) | (0.13) | (0.12) | (0.12) | (0.14) | (0.14) | (0.14) |
| MR_trade_fnd | 1.42*** | 1.19** | 0.80** | 1.21*** | 1.27*** | 2.00*** | 2.00*** | 1.36*** | 1.32*** | 1.41*** | 0.64 | 0.98* | 0.87* | 0.75 | 0.43 | -0.20 | -0.90 | -0.66 | 0.11 |
| | (0.47) | (0.55) | (0.32) | (0.42) | (0.47) | (0.55) | (0.66) | (0.43) | (0.41) | (0.52) | (0.45) | (0.51) | (0.45) | (0.55) | (0.48) | (0.68) | (0.72) | (0.85) | (0.98) |
| Constant | 87.28*** | 65.52*** | 108.33*** | 118.16*** | 133.63*** | 105.77*** | 124.51*** | 116.99*** | 103.75*** | 108.78*** | 111.77*** | 101.46*** | 100.30*** | 84.68*** | 84.88*** | 77.60*** | 56.76** | 60.18*** | 71.22*** |
| | (24.38) | (23.12) | (31.24) | (25.64) | (23.67) | (24.56) | (23.16) | (24.99) | (24.41) | (25.33) | (23.53) | (22.10) | (24.36) | (24.58) | (21.60) | (18.93) | (22.65) | (21.41) | (23.65) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.51 | 0.38 | 0.52 | 0.55 | 0.59 | 0.59 | 0.55 | 0.55 | 0.51 | 0.55 | 0.51 | 0.48 | 0.54 | 0.53 | 0.48 | 0.51 | 0.51 | 0.49 | 0.39 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

## Table A.8: SITC 5 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.81*** | 0.82*** | 0.87*** | 0.85*** | 0.83*** | 0.83*** | 0.78*** | 0.85*** | 0.84*** | 0.82*** | 0.81*** | 0.83*** | 0.85*** | 0.85*** | 0.85*** | 0.86*** | 0.88*** | 0.86*** | 0.86*** |
| | (0.04) | (0.04) | (0.04) | (0.05) | (0.05) | (0.05) | (0.11) | (0.09) | (0.07) | (0.08) | (0.07) | (0.07) | (0.06) | (0.06) | (0.06) | (0.06) | (0.05) | (0.06) | (0.06) |
| ln_expGDPinmil | 0.93*** | 0.88*** | 0.87*** | 0.77*** | 0.75*** | 0.76*** | 0.66*** | 0.73*** | 0.76*** | 0.75*** | 0.76*** | 0.75*** | 0.77*** | 0.74*** | 0.74*** | 0.74*** | 0.76*** | 0.73*** | 0.76*** |
| | (0.07) | (0.07) | (0.09) | (0.07) | (0.07) | (0.08) | (0.12) | (0.09) | (0.08) | (0.08) | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.06) | (0.06) | (0.06) | (0.06) |
| MR_ln_distw | -0.99*** | -1.00*** | -0.84*** | -1.07*** | -1.07*** | -1.03*** | -1.05*** | -0.93*** | -0.86*** | -0.81*** | -0.73*** | -0.67** | -0.66*** | -0.79*** | -0.82*** | -0.99*** | -1.09*** | -0.99*** | -0.98*** |
| | (0.18) | (0.20) | (0.22) | (0.14) | (0.16) | (0.15) | (0.18) | (0.21) | (0.25) | (0.24) | (0.28) | (0.28) | (0.25) | (0.21) | (0.19) | (0.21) | (0.21) | (0.22) | (0.22) |
| MR_contig | 0.21 | 0.26 | 0.18 | -0.04 | 0.01 | -0.08 | 0.07 | 0.02 | 0.06 | -0.02 | 0.11 | 0.25 | 0.28 | 0.13 | 0.22 | 0.15 | 0.01 | 0.14 | 0.18 |
| | (0.15) | (0.17) | (0.16) | (0.15) | (0.20) | (0.17) | (0.20) | (0.18) | (0.20) | (0.22) | (0.22) | (0.24) | (0.22) | (0.22) | (0.23) | (0.24) | (0.24) | (0.25) | (0.24) |
| MR_comlang | -0.31 | -0.36 | -0.25 | 0.65*** | 0.66*** | 0.72*** | 0.73 | 0.87* | 0.91* | 0.89* | 0.91 | 0.83 | 0.94* | 1.05* | 0.95* | 0.79* | 0.68* | 0.72* | 0.62 |
| | (0.53) | (0.53) | (0.50) | (0.23) | (0.25) | (0.28) | (0.45) | (0.45) | (0.52) | (0.49) | (0.55) | (0.54) | (0.55) | (0.55) | (0.52) | (0.44) | (0.40) | (0.43) | (0.38) |
| MR_west_to_east | -2.37 | -5.74 | -8.47* | -19.35*** | -16.60*** | -18.24*** | -18.19*** | -19.48*** | -17.83*** | -16.99*** | -16.25*** | -15.76*** | -14.87*** | -16.39*** | -14.64*** | -14.04*** | -13.75*** | -13.75*** | -12.46*** |
| | (3.96) | (3.85) | (4.39) | (2.56) | (2.36) | (2.41) | (3.01) | (2.46) | (2.16) | (2.15) | (1.81) | (1.70) | (1.63) | (1.71) | (1.55) | (1.60) | (1.65) | (1.78) | (1.70) |
| MR_east_to_west | -0.27 | 3.47 | 6.10 | 17.76*** | 15.40*** | 17.00*** | 18.00*** | 18.26*** | 15.90*** | 15.22*** | 15.33*** | 14.85*** | 14.05*** | 15.53*** | 14.07*** | 13.61*** | 13.21*** | 13.15*** | 11.82*** |
| | (3.87) | (3.87) | (4.58) | (2.59) | (2.37) | (2.57) | (2.85) | (2.29) | (2.10) | (2.10) | (1.82) | (1.70) | (1.61) | (1.70) | (1.50) | (1.54) | (1.60) | (1.71) | (1.66) |
| MR_EU | -0.85 | -0.77 | -0.40 | 1.33* | 1.14 | 1.20 | 1.68 | 1.66 | | | | | | | | | | | |
| | (0.73) | (0.80) | (0.72) | (0.70) | (0.76) | (0.82) | (1.07) | (1.16) | | | | | | | | | | | |
| MR_nonEUrta | 0.93* | 0.67 | 1.10** | 1.38* | 1.15 | 1.00 | 0.44 | 0.97 | -1.44 | -1.66 | -0.29 | | | | | | | | |
| | (0.53) | (0.53) | (0.46) | (0.74) | (0.78) | (0.78) | (0.76) | (0.71) | (0.94) | (1.07) | (0.75) | | | | | | | | |
| MR_landlock_imp | 6.86 | 6.29 | 4.33 | -7.81 | -11.06** | -12.05** | -14.98** | -12.65** | -11.80* | -10.44* | -9.43 | -8.47 | -8.73 | -11.59* | -10.19* | -9.29* | -8.42 | -8.22 | -4.15 |
| | (5.18) | (5.13) | (5.32) | (4.82) | (4.86) | (5.66) | (7.27) | (5.47) | (6.02) | (5.63) | (5.77) | (5.25) | (5.60) | (6.09) | (5.66) | (5.56) | (5.31) | (5.29) | (5.10) |
| MR_landlock_exp | 8.58 | 8.60 | 8.20 | 3.15 | 1.86 | 2.08 | -0.54 | 0.71 | -0.86 | -0.79 | -1.92 | 0.42 | -0.16 | -1.52 | -0.24 | 1.40 | 1.77 | 2.23 | 3.15 |
| | (6.35) | (6.54) | (5.91) | (3.95) | (3.80) | (3.90) | (4.89) | (4.13) | (4.27) | (4.64) | (4.57) | (4.13) | (4.05) | (4.18) | (4.05) | (3.71) | (3.64) | (3.64) | (3.77) |
| MR_comcol | 2.58*** | 2.32*** | 2.66*** | 1.74*** | 1.68*** | 1.73*** | 1.30** | 1.56** | 1.71** | 1.58*** | 1.77*** | 1.58*** | 2.01*** | 2.00*** | 2.02*** | 1.73*** | 1.89*** | 1.83*** | 1.82*** |
| | (0.79) | (0.81) | (0.60) | (0.48) | (0.45) | (0.43) | (0.62) | (0.66) | (0.68) | (0.58) | (0.66) | (0.61) | (0.58) | (0.54) | (0.51) | (0.57) | (0.49) | (0.46) | (0.48) |
| MR_soc_bus_fnd | -0.05 | -0.03 | -0.07 | 0.00 | 0.09 | 0.01 | 0.12 | -0.07 | -0.10 | -0.19* | -0.11 | -0.11 | -0.11 | -0.06 | -0.05 | 0.00 | 0.04 | 0.04 | 0.06 |
| | (0.07) | (0.08) | (0.06) | (0.07) | (0.07) | (0.06) | (0.11) | (0.07) | (0.08) | (0.11) | (0.08) | (0.07) | (0.07) | (0.08) | (0.08) | (0.07) | (0.07) | (0.07) | (0.07) |
| MR_gov_fisc_fnd | -0.02 | -0.06 | -0.12** | -0.16*** | -0.09 | -0.11* | -0.03 | -0.04 | -0.05 | -0.08 | -0.13 | -0.16* | -0.07 | -0.08 | -0.10 | -0.02 | 0.08 | 0.02 | 0.05 |
| | (0.07) | (0.08) | (0.05) | (0.05) | (0.06) | (0.06) | (0.11) | (0.10) | (0.11) | (0.12) | (0.10) | (0.09) | (0.10) | (0.13) | (0.11) | (0.13) | (0.14) | (0.14) | (0.14) |
| MR_trade_fnd | 0.02 | 0.05 | 0.00 | 0.12 | -0.03 | 0.07 | -0.01 | 0.61** | 0.40* | 0.58** | 0.31 | 0.54** | 0.31* | 0.12 | 0.19 | -0.52 | -1.05*** | -0.49 | -0.82* |
| | (0.16) | (0.15) | (0.12) | (0.19) | (0.17) | (0.25) | (0.31) | (0.26) | (0.24) | (0.29) | (0.26) | (0.23) | (0.19) | (0.23) | (0.25) | (0.42) | (0.37) | (0.43) | (0.45) |
| Constant | 22.06 | 22.67 | 14.09 | 51.89*** | 61.06*** | 59.78*** | 70.40*** | 56.23*** | 63.57*** | 59.37*** | 51.41*** | 43.09** | 42.16*** | 56.61*** | 54.13*** | 55.78*** | 57.13*** | 53.25*** | 42.97** |
| | (19.18) | (20.38) | (18.30) | (13.55) | (12.90) | (12.79) | (20.40) | (17.45) | (19.80) | (21.70) | (19.11) | (19.70) | (15.31) | (13.97) | (14.19) | (15.78) | (16.64) | (16.03) | (16.76) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.86 | 0.83 | 0.83 | 0.85 | 0.82 | 0.81 | 0.64 | 0.70 | 0.65 | 0.66 | 0.64 | 0.64 | 0.65 | 0.63 | 0.67 | 0.68 | 0.70 | 0.66 | 0.69 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

Table A.9: SITC 6 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.86*** | 0.86*** | 0.86*** | 0.87*** | 0.86*** | 0.86*** | 0.84*** | 0.85*** | 0.80*** | 0.81*** | 0.82*** | 0.83*** | 0.84*** | 0.83*** | 0.85*** | 0.87*** | 0.85*** | 0.85*** | 0.84*** |
| | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| ln_expGDPinmil | 0.86*** | 0.85*** | 0.86*** | 0.83*** | 0.81*** | 0.83*** | 0.83*** | 0.83*** | 0.77*** | 0.79*** | 0.79*** | 0.78*** | 0.79*** | 0.80*** | 0.79*** | 0.79*** | 0.78*** | 0.78*** | 0.78*** |
| | (0.06) | (0.06) | (0.06) | (0.04) | (0.05) | (0.04) | (0.04) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| MR_ln_distw | -0.69*** | -0.69*** | -0.61** | -0.98*** | -1.02*** | -0.90*** | -0.86*** | -0.78*** | -0.75*** | -0.71*** | -0.71*** | -0.61*** | -0.73*** | -0.75*** | -0.73*** | -0.75*** | -0.71*** | -0.68*** | -0.61*** |
| | (0.19) | (0.21) | (0.24) | (0.19) | (0.18) | (0.17) | (0.17) | (0.18) | (0.17) | (0.17) | (0.17) | (0.18) | (0.18) | (0.17) | (0.18) | (0.17) | (0.18) | (0.19) | (0.19) |
| MR_contig | 0.47*** | 0.55*** | 0.55*** | 0.23 | 0.29 | 0.31* | 0.42** | 0.50*** | 0.56*** | 0.63*** | 0.62*** | 0.71*** | 0.64*** | 0.61*** | 0.62** | 0.62** | 0.64** | 0.69** | 0.76*** |
| | (0.17) | (0.17) | (0.21) | (0.18) | (0.20) | (0.18) | (0.18) | (0.18) | (0.21) | (0.21) | (0.22) | (0.23) | (0.24) | (0.24) | (0.24) | (0.25) | (0.26) | (0.27) | (0.27) |
| MR_comlang | 0.04 | -0.05 | -0.03 | 0.59*** | 0.50*** | 0.49*** | 0.43** | 0.48** | 0.44** | 0.40* | 0.42* | 0.46* | 0.50** | 0.48** | 0.49** | 0.42* | 0.35 | 0.35 | 0.33 |
| | (0.45) | (0.42) | (0.43) | (0.19) | (0.18) | (0.18) | (0.19) | (0.21) | (0.21) | (0.23) | (0.22) | (0.26) | (0.23) | (0.21) | (0.22) | (0.22) | (0.23) | (0.24) | (0.25) |
| MR_west_to_east | -0.36 | -1.24 | -2.18 | -6.04*** | -5.50*** | -5.44*** | -5.16*** | -5.75*** | -2.81** | -2.40* | -3.01** | -3.76*** | -3.39*** | -2.33* | -2.61** | -2.24** | -1.96* | -1.76 | -1.79 |
| | (2.27) | (2.10) | (2.02) | (1.64) | (1.62) | (1.55) | (1.52) | (1.50) | (1.42) | (1.43) | (1.40) | (1.30) | (1.23) | (1.19) | (1.12) | (1.11) | (1.15) | (1.15) | (1.11) |
| MR_east_to_west | -1.39 | -0.31 | 0.34 | 4.43*** | 4.20*** | 3.78** | 3.67** | 4.02*** | 3.89*** | 3.66*** | 4.27*** | 4.63*** | 4.25*** | 3.46*** | 3.66*** | 3.32*** | 2.83** | 2.65** | 2.67** |
| | (2.22) | (2.07) | (2.01) | (1.56) | (1.58) | (1.55) | (1.51) | (1.50) | (1.44) | (1.39) | (1.36) | (1.31) | (1.26) | (1.27) | (1.20) | (1.20) | (1.23) | (1.23) | (1.14) |
| MR_EU | -1.11 | -1.11 | -1.46* | 0.31 | 0.13 | 0.11 | -0.26 | -0.41 | | | | | | | | | | | |
| | (0.84) | (0.84) | (0.77) | (0.75) | (0.77) | (0.77) | (0.80) | (0.86) | | | | | | | | | | | |
| MR_nonEUrta | 0.27 | -0.20 | 0.36 | 1.66** | 1.52* | 1.84** | 1.65** | 1.81** | 3.04 | 3.36 | 1.64 | | | | | | | | |
| | (0.80) | (0.76) | (0.71) | (0.81) | (0.83) | (0.81) | (0.82) | (0.89) | (4.13) | (3.62) | (3.16) | | | | | | | | |
| MR_landlock_imp | 14.30*** | 15.59*** | 16.74*** | 13.54*** | 11.40*** | 13.55*** | 12.94*** | 13.04*** | 13.05*** | 13.31*** | 12.42*** | 13.26*** | 14.83*** | 15.43*** | 14.45*** | 14.18*** | 15.31*** | 14.64*** | 14.70*** |
| | (4.58) | (4.44) | (3.90) | (3.18) | (3.53) | (3.07) | (2.85) | (2.97) | (3.52) | (3.43) | (3.42) | (3.47) | (3.28) | (3.31) | (3.38) | (3.40) | (3.55) | (3.61) | (3.58) |
| MR_landlock_exp | 10.20** | 11.03** | 9.88** | 8.63** | 7.76** | 9.74*** | 7.81** | 7.26** | 8.58** | 9.08** | 9.98*** | 11.19*** | 12.11*** | 11.80*** | 13.32*** | 14.25*** | 14.82*** | 14.79*** | 14.77*** |
| | (5.15) | (5.17) | (4.77) | (3.80) | (3.62) | (3.66) | (3.62) | (3.58) | (3.80) | (3.77) | (3.64) | (3.87) | (3.68) | (4.13) | (3.94) | (3.90) | (4.04) | (4.05) | (3.97) |
| MR_comcol | 2.98*** | 3.15*** | 2.92*** | 2.23*** | 2.00*** | 2.24*** | 1.93*** | 2.18*** | 2.17*** | 2.22*** | 2.27*** | 2.37*** | 2.15*** | 2.27*** | 2.44*** | 2.40*** | 2.58*** | 2.65*** | 2.77*** |
| | (1.08) | (1.03) | (0.70) | (0.52) | (0.49) | (0.48) | (0.46) | (0.47) | (0.47) | (0.46) | (0.43) | (0.46) | (0.45) | (0.51) | (0.53) | (0.56) | (0.55) | (0.51) | (0.48) |
| MR_soc_bus_fnd | -0.00 | -0.05 | -0.07 | 0.02 | 0.13 | 0.05 | 0.03 | -0.03 | -0.02 | -0.03 | -0.04 | -0.03 | -0.00 | -0.02 | -0.01 | -0.01 | -0.00 | 0.00 | -0.02 |
| | (0.06) | (0.07) | (0.06) | (0.08) | (0.09) | (0.09) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.07) | (0.06) | (0.06) | (0.07) |
| MR_gov_fisc_fnd | -0.05 | -0.08 | -0.08 | -0.20*** | -0.17*** | -0.19*** | -0.18*** | -0.18*** | -0.17*** | -0.22*** | -0.18*** | -0.14* | -0.13** | -0.16** | -0.13* | -0.08 | -0.02 | -0.02 | 0.01 |
| | (0.06) | (0.07) | (0.06) | (0.06) | (0.06) | (0.06) | (0.05) | (0.06) | (0.06) | (0.06) | (0.06) | (0.08) | (0.07) | (0.07) | (0.07) | (0.08) | (0.10) | (0.11) | (0.11) |
| MR_trade_fnd | 0.14 | 0.25 | 0.13 | 0.32* | 0.18 | 0.20 | 0.13 | 0.14 | -0.04 | -0.18 | -0.34* | 0.06 | -0.07 | 0.02 | -0.01 | -0.46 | -0.52* | -0.32 | -0.32 |
| | (0.14) | (0.15) | (0.16) | (0.18) | (0.14) | (0.16) | (0.16) | (0.18) | (0.15) | (0.18) | (0.17) | (0.18) | (0.18) | (0.22) | (0.22) | (0.34) | (0.31) | (0.30) | (0.30) |
| Constant | -7.82 | -10.78 | -14.71 | 2.99 | 12.13 | -2.53 | 1.56 | -2.97 | -9.45 | -14.68 | -13.63 | -18.36 | -16.27 | -15.76 | -17.63 | -20.55 | -25.22* | -24.71 | -29.35* |
| | (18.07) | (18.88) | (18.93) | (16.77) | (14.54) | (14.43) | (14.11) | (16.05) | (15.59) | (15.56) | (13.96) | (14.53) | (13.17) | (13.95) | (13.74) | (13.00) | (14.39) | (15.39) | (16.44) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.83 | 0.83 | 0.82 | 0.85 | 0.83 | 0.83 | 0.83 | 0.81 | 0.79 | 0.78 | 0.77 | 0.74 | 0.76 | 0.77 | 0.76 | 0.76 | 0.75 | 0.75 | 0.74 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |

Table A.10: SITC 7 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.91*** | 0.89*** | 0.89*** | 0.90*** | 0.88*** | 0.92*** | 0.91*** | 0.95*** | 0.90*** | 0.88*** | 0.85*** | 0.86*** | 0.87*** | 0.91*** | 0.92*** | 0.93*** | 0.93*** | 0.91*** | 0.91*** |
| | (0.04) | (0.05) | (0.04) | (0.03) | (0.04) | (0.03) | (0.03) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| ln_expGDPinmil | 1.07*** | 1.02*** | 1.06*** | 1.03*** | 0.99*** | 1.03*** | 1.06*** | 1.07*** | 1.03*** | 1.03*** | 1.05*** | 1.01*** | 1.03*** | 1.03*** | 1.05*** | 1.05*** | 1.04*** | 1.01*** | 1.01*** |
| | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |
| MR_ln_distw | -0.85*** | -0.86*** | -0.71*** | -0.99*** | -0.94*** | -0.96*** | -0.90*** | -0.82*** | -0.73*** | -0.68*** | -0.74*** | -0.56*** | -0.59*** | -0.50** | -0.51** | -0.66*** | -0.70*** | -0.66*** | -0.62*** |
| | (0.17) | (0.20) | (0.21) | (0.16) | (0.17) | (0.13) | (0.14) | (0.15) | (0.15) | (0.15) | (0.14) | (0.21) | (0.22) | (0.21) | (0.22) | (0.23) | (0.22) | (0.23) | (0.20) |
| MR_contig | 0.14 | 0.18 | 0.26 | 0.01 | 0.10 | 0.06 | 0.13 | 0.15 | 0.19 | 0.24 | 0.15 | 0.36 | 0.35 | 0.47** | 0.52** | 0.41 | 0.40 | 0.43* | 0.47** |
| | (0.13) | (0.15) | (0.17) | (0.16) | (0.19) | (0.16) | (0.17) | (0.17) | (0.18) | (0.19) | (0.17) | (0.23) | (0.24) | (0.23) | (0.24) | (0.26) | (0.25) | (0.26) | (0.24) |
| MR_comlang | 0.16 | 0.01 | -0.01 | 0.51*** | 0.43*** | 0.51*** | 0.54*** | 0.41* | 0.40* | 0.38* | 0.29 | 0.34 | 0.38* | 0.35 | 0.27 | 0.24 | 0.15 | 0.14 | 0.11 |
| | (0.46) | (0.43) | (0.41) | (0.16) | (0.15) | (0.15) | (0.16) | (0.21) | (0.22) | (0.22) | (0.21) | (0.23) | (0.22) | (0.23) | (0.23) | (0.22) | (0.25) | (0.24) | (0.22) |
| MR_west_to_east | 0.67 | 1.03 | 3.64* | 0.37 | 0.76 | 1.11 | 2.50* | 1.73 | 4.13*** | 4.40*** | 4.24*** | 3.70*** | 4.23*** | 7.95*** | 7.45*** | 6.34*** | 5.41*** | 5.26*** | 5.38*** |
| | (2.58) | (2.47) | (2.06) | (1.69) | (1.45) | (1.39) | (1.30) | (1.23) | (1.24) | (1.27) | (1.19) | (1.24) | (1.21) | (1.31) | (1.20) | (1.29) | (1.28) | (1.26) | (1.18) |
| MR_east_to_west | -1.77 | -1.70 | -4.09** | -0.91 | -0.71 | -1.46 | -3.34** | -2.98** | -2.23* | -2.48** | -2.42** | -2.13 | -2.71** | -6.07*** | -5.57*** | -4.47*** | -3.85*** | -3.86*** | -4.01*** |
| | (2.40) | (2.43) | (2.01) | (1.72) | (1.49) | (1.43) | (1.35) | (1.28) | (1.15) | (1.25) | (1.19) | (1.36) | (1.36) | (1.51) | (1.40) | (1.43) | (1.43) | (1.42) | (1.37) |
| MR_EU | -1.78** | -1.37* | -1.75** | -1.14 | -1.71* | -1.29 | -1.48* | -1.43* | | | | | | | | | | | |
| | (0.75) | (0.80) | (0.77) | (0.87) | (0.89) | (0.84) | (0.79) | (0.78) | | | | | | | | | | | |
| MR_nonEUrta | -0.64 | -0.72 | -0.57 | -0.35 | -0.75 | 0.13 | 0.52 | 1.06 | -0.06 | 0.70 | 0.36 | | | | | | | | |
| | (0.51) | (0.50) | (0.50) | (0.86) | (0.96) | (0.89) | (0.82) | (0.80) | (1.78) | (1.75) | (1.96) | | | | | | | | |
| MR_landlock_imp | 12.74** | 16.55*** | 18.13*** | 16.06*** | 14.36*** | 16.22*** | 18.08*** | 18.02*** | 19.30*** | 18.87*** | 21.72*** | 22.70*** | 24.15*** | 22.40*** | 24.50*** | 24.42*** | 25.45*** | 24.88*** | 25.56*** |
| | (5.54) | (5.67) | (4.82) | (4.55) | (4.16) | (3.89) | (3.42) | (3.49) | (3.63) | (3.43) | (3.45) | (3.51) | (3.35) | (3.54) | (3.68) | (3.63) | (3.72) | (3.70) | (3.82) |
| MR_landlock_exp | 11.07** | 11.24** | 10.10** | 8.82** | 8.06** | 9.49*** | 8.09** | 10.45*** | 9.78** | 9.48** | 9.94** | 10.98*** | 11.27*** | 13.61*** | 15.11*** | 14.79*** | 15.80*** | 15.63*** | 16.06*** |
| | (5.02) | (5.33) | (4.64) | (3.99) | (3.62) | (3.40) | (3.30) | (3.52) | (3.84) | (4.02) | (3.95) | (4.26) | (4.19) | (4.37) | (4.35) | (4.14) | (4.30) | (4.30) | (4.31) |
| MR_comcol | 3.63*** | 3.65*** | 2.33 | 2.14** | 1.92* | 2.36*** | 2.56*** | 2.95*** | 2.65*** | 3.19*** | 3.27*** | 3.57*** | 3.48*** | 3.95*** | 4.23*** | 4.07*** | 4.13*** | 3.84*** | 4.03*** |
| | (1.11) | (0.99) | (1.63) | (1.00) | (1.14) | (0.89) | (0.74) | (0.67) | (0.94) | (0.72) | (0.65) | (0.53) | (0.49) | (0.55) | (0.61) | (0.61) | (0.62) | (0.59) | (0.56) |
| MR_soc_bus_fnd | -0.02 | -0.04 | -0.08 | -0.08 | -0.02 | -0.08 | -0.06 | -0.09* | -0.10* | -0.09 | -0.08* | -0.06 | -0.04 | -0.09 | -0.09 | -0.03 | -0.01 | -0.01 | -0.04 |
| | (0.06) | (0.07) | (0.05) | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.06) | (0.04) | (0.05) | (0.05) | (0.06) | (0.06) | (0.07) | (0.07) | (0.06) | (0.07) |
| MR_gov_fisc_fnd | 0.09 | 0.04 | -0.00 | -0.10** | -0.07 | -0.09** | -0.06 | -0.10* | -0.11* | -0.12* | -0.08 | -0.10 | -0.08 | -0.14* | -0.11 | -0.06 | 0.06 | 0.05 | 0.10 |
| | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.06) | (0.07) | (0.06) | (0.06) | (0.08) | (0.06) | (0.08) | (0.08) | (0.10) | (0.11) | (0.11) | (0.11) |
| MR_trade_fnd | 0.03 | 0.09 | 0.02 | 0.33* | 0.04 | 0.05 | -0.08 | -0.01 | -0.05 | -0.18 | -0.29 | 0.03 | 0.01 | 0.27 | 0.35 | -0.33 | -0.65* | -0.51 | -0.43 |
| | (0.14) | (0.15) | (0.15) | (0.19) | (0.18) | (0.18) | (0.14) | (0.17) | (0.17) | (0.19) | (0.23) | (0.24) | (0.21) | (0.26) | (0.27) | (0.40) | (0.36) | (0.34) | (0.31) |
| Constant | 3.42 | -2.61 | -10.80 | 6.21 | 11.74 | 2.64 | -1.73 | -12.07 | -23.96* | -26.51* | -28.16** | -40.53** | -41.94*** | -48.64*** | -53.85*** | -47.66*** | -49.74*** | -49.27*** | -52.83*** |
| | (18.47) | (19.15) | (16.95) | (14.36) | (13.79) | (12.37) | (11.99) | (14.05) | (14.37) | (14.05) | (13.82) | (16.22) | (16.09) | (16.54) | (17.35) | (16.15) | (16.30) | (16.92) | (16.08) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.91 | 0.88 | 0.89 | 0.90 | 0.88 | 0.88 | 0.87 | 0.85 | 0.82 | 0.81 | 0.83 | 0.76 | 0.76 | 0.78 | 0.80 | 0.78 | 0.79 | 0.78 | 0.79 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |

## Table A.11: SITC 8 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.94*** | 0.87*** | 0.88*** | 0.88*** | 0.87*** | 0.86*** | 0.86*** | 0.87*** | 0.86*** | 0.84*** | 0.83*** | 0.80*** | 0.82*** | 0.83*** | 0.84*** | 0.86*** | 0.86*** | 0.86*** | 0.86*** |
| | (0.08) | (0.07) | (0.06) | (0.05) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.05) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| ln_expGDPinmil | 0.83*** | 0.79*** | 0.83*** | 0.81*** | 0.80*** | 0.81*** | 0.85*** | 0.82*** | 0.84*** | 0.86*** | 0.87*** | 0.85*** | 0.86*** | 0.85*** | 0.85*** | 0.85*** | 0.84*** | 0.84*** | 0.83*** |
| | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| MR_ln_distw | -0.87*** | -0.83*** | -0.85*** | -1.01*** | -1.05*** | -0.99*** | -0.97*** | -0.93*** | -0.93*** | -0.89*** | -0.88*** | -0.80*** | -0.90*** | -0.89*** | -0.87*** | -0.88*** | -0.87*** | -0.88*** | -0.84*** |
| | (0.18) | (0.21) | (0.24) | (0.18) | (0.15) | (0.15) | (0.14) | (0.15) | (0.13) | (0.13) | (0.15) | (0.15) | (0.17) | (0.18) | (0.17) | (0.15) | (0.16) | (0.16) | (0.17) |
| MR_contig | 0.25 | 0.30 | 0.34 | 0.15 | 0.18 | 0.18 | 0.23 | 0.33** | 0.37** | 0.44*** | 0.44*** | 0.52*** | 0.43** | 0.45** | 0.49** | 0.49** | 0.48** | 0.51*** | 0.57*** |
| | (0.20) | (0.18) | (0.22) | (0.18) | (0.18) | (0.16) | (0.14) | (0.13) | (0.15) | (0.15) | (0.16) | (0.18) | (0.20) | (0.20) | (0.20) | (0.20) | (0.20) | (0.20) | (0.21) |
| MR_comlang | 0.59 | 0.41 | 0.47 | 0.72*** | 0.61*** | 0.61*** | 0.59*** | 0.56** | 0.54** | 0.52** | 0.51** | 0.53** | 0.56** | 0.56** | 0.51** | 0.47** | 0.43* | 0.39 | 0.34 |
| | (0.41) | (0.39) | (0.40) | (0.25) | (0.22) | (0.23) | (0.21) | (0.25) | (0.23) | (0.24) | (0.22) | (0.25) | (0.22) | (0.22) | (0.23) | (0.22) | (0.23) | (0.24) | (0.26) |
| MR_west_to_east | 6.96** | 6.58** | 7.67*** | 4.76** | 4.99*** | 5.82*** | 6.88*** | 6.38*** | 8.44*** | 8.85*** | 8.11*** | 7.39*** | 6.26*** | 6.59*** | 6.69*** | 6.71*** | 6.83*** | 7.07*** | 6.67*** |
| | (3.01) | (2.72) | (2.60) | (1.90) | (1.69) | (1.75) | (1.87) | (1.80) | (1.78) | (1.80) | (1.68) | (1.69) | (1.51) | (1.56) | (1.47) | (1.45) | (1.48) | (1.49) | (1.42) |
| MR_east_to_west | -7.86*** | -6.63** | -7.99*** | -5.25*** | -5.33*** | -6.49*** | -7.83*** | -7.18*** | -7.30*** | -7.60*** | -6.75*** | -6.23*** | -5.03*** | -5.19*** | -5.27*** | -5.17*** | -5.50*** | -5.68*** | -5.27*** |
| | (2.94) | (2.68) | (2.62) | (1.94) | (1.75) | (1.77) | (1.87) | (1.81) | (1.83) | (1.76) | (1.62) | (1.67) | (1.52) | (1.63) | (1.56) | (1.52) | (1.51) | (1.52) | (1.48) |
| MR_EU | -0.34 | 0.37 | -0.91 | -0.73 | -0.78 | -0.71 | -1.07 | -1.11 | | | | | | | | | | | |
| | (0.98) | (0.95) | (0.74) | (0.70) | (0.65) | (0.68) | (0.69) | (0.72) | | | | | | | | | | | |
| MR_nonEUrta | 0.23 | -0.30 | -0.10 | 0.27 | 0.30 | 0.65 | 0.77 | 0.77 | 11.10*** | 10.11** | 8.31** | | | | | | | | |
| | (0.83) | (0.69) | (0.58) | (0.71) | (0.68) | (0.69) | (0.73) | (0.74) | (4.02) | (4.13) | (4.09) | | | | | | | | |
| MR_landlock_imp | -0.18 | 3.10 | 3.98 | 2.23 | 1.21 | 3.09 | 4.17 | 1.51 | 4.75 | 5.43 | 5.65* | 5.66 | 6.78** | 5.91 | 6.56* | 6.42* | 6.41* | 6.40* | 7.02* |
| | (4.32) | (4.20) | (4.00) | (3.98) | (4.10) | (3.94) | (3.79) | (3.80) | (3.64) | (3.50) | (3.41) | (3.53) | (3.41) | (3.60) | (3.64) | (3.67) | (3.69) | (3.74) | (3.84) |
| MR_landlock_exp | 16.43*** | 13.66*** | 12.68** | 11.68** | 10.04** | 11.10** | 10.80** | 10.20** | 12.77*** | 12.34*** | 11.43*** | 9.76** | 10.05** | 11.36** | 11.99** | 13.24*** | 13.80*** | 14.23*** | 13.85*** |
| | (5.06) | (5.20) | (5.25) | (5.39) | (4.74) | (5.02) | (4.99) | (4.63) | (4.60) | (4.67) | (4.33) | (4.48) | (4.33) | (4.85) | (4.85) | (4.61) | (4.72) | (4.71) | (4.78) |
| MR_comcol | 2.81** | 2.80*** | 2.09* | 1.95*** | 1.89*** | 1.90*** | 1.94*** | 1.90*** | 1.59* | 2.03*** | 2.06*** | 2.14*** | 2.04*** | 2.24*** | 2.31*** | 2.32*** | 2.47*** | 2.47*** | 2.44*** |
| | (1.37) | (1.03) | (1.10) | (0.74) | (0.62) | (0.64) | (0.63) | (0.57) | (0.95) | (0.64) | (0.58) | (0.49) | (0.49) | (0.55) | (0.56) | (0.57) | (0.57) | (0.48) | (0.50) |
| MR_soc_bus_fnd | -0.06 | -0.10 | -0.08 | 0.01 | 0.06 | 0.00 | -0.03 | -0.02 | -0.01 | -0.00 | -0.01 | 0.01 | 0.02 | 0.00 | -0.00 | 0.01 | 0.04 | 0.04 | 0.02 |
| | (0.07) | (0.07) | (0.06) | (0.06) | (0.07) | (0.07) | (0.05) | (0.04) | (0.04) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) |
| MR_gov_fisc_fnd | 0.01 | -0.06 | -0.00 | -0.13** | -0.12** | -0.13** | -0.17*** | -0.16** | -0.17*** | -0.19*** | -0.18*** | -0.14** | -0.14** | -0.18** | -0.17** | -0.18** | -0.10 | -0.12 | -0.09 |
| | (0.07) | (0.08) | (0.07) | (0.06) | (0.06) | (0.05) | (0.05) | (0.06) | (0.06) | (0.06) | (0.06) | (0.07) | (0.07) | (0.07) | (0.07) | (0.08) | (0.09) | (0.09) | (0.09) |
| MR_trade_fnd | 0.31** | 0.38** | 0.19 | 0.25 | 0.19 | 0.19 | 0.29* | 0.13 | 0.08 | -0.07 | -0.23 | 0.02 | -0.15 | -0.06 | 0.02 | -0.15 | -0.46* | -0.30 | -0.17 |
| | (0.15) | (0.16) | (0.16) | (0.17) | (0.15) | (0.18) | (0.16) | (0.19) | (0.14) | (0.18) | (0.20) | (0.19) | (0.18) | (0.18) | (0.16) | (0.29) | (0.25) | (0.28) | (0.30) |
| Constant | 11.68 | 7.20 | 13.05 | 23.94 | 31.34* | 21.80 | 20.39 | 23.20 | -3.83 | -6.14 | -4.48 | 5.53 | 8.53 | 7.20 | 4.01 | 0.98 | -1.60 | -0.71 | -2.21 |
| | (17.17) | (18.92) | (18.43) | (20.06) | (17.94) | (18.48) | (17.57) | (18.56) | (17.97) | (17.97) | (16.11) | (15.96) | (15.15) | (16.99) | (16.79) | (15.05) | (15.95) | (16.60) | (17.49) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.71 | 0.73 | 0.74 | 0.80 | 0.80 | 0.80 | 0.81 | 0.80 | 0.81 | 0.80 | 0.80 | 0.77 | 0.78 | 0.80 | 0.79 | 0.80 | 0.78 | 0.79 | 0.78 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Table A.12: SITC 9 - PPML Estimates

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ln_impGDPinmil | 0.81*** | 0.83*** | 0.86*** | 0.88*** | 0.95*** | 0.97*** | 0.94*** | 1.00*** | 0.98*** | 0.93*** | 0.93*** | 0.91*** | 1.02*** | 0.96*** | 0.99*** | 0.95*** | 1.00*** | 0.88*** | 0.81*** |
| | (0.10) | (0.12) | (0.13) | (0.11) | (0.08) | (0.08) | (0.07) | (0.08) | (0.09) | (0.08) | (0.11) | (0.07) | (0.10) | (0.09) | (0.10) | (0.06) | (0.07) | (0.07) | (0.07) |
| ln_expGDPinmil | 1.85*** | 1.09*** | 0.84*** | 1.14*** | 1.41*** | 1.06*** | 0.97*** | 1.51*** | 1.34*** | 0.94*** | 0.97*** | 1.22*** | 1.19*** | 1.26*** | 1.27*** | 1.47*** | 1.32*** | 1.25*** | 1.16*** |
| | (0.35) | (0.22) | (0.16) | (0.18) | (0.13) | (0.09) | (0.08) | (0.15) | (0.10) | (0.07) | (0.10) | (0.09) | (0.12) | (0.12) | (0.13) | (0.09) | (0.09) | (0.09) | (0.10) |
| MR_ln_distw | 0.13 | -0.43 | -0.47 | -0.41 | -0.65* | -1.04*** | -1.00*** | -0.26 | -0.79*** | -1.16*** | -1.14*** | -0.68** | -0.62** | -0.86*** | -0.89*** | -0.85*** | -0.93*** | -1.00*** | -0.61** |
| | (0.47) | (0.50) | (0.57) | (0.56) | (0.34) | (0.23) | (0.23) | (0.28) | (0.27) | (0.20) | (0.26) | (0.29) | (0.27) | (0.29) | (0.30) | (0.19) | (0.21) | (0.22) | (0.27) |
| MR_contig | 0.02 | 0.01 | -0.18 | -0.30 | -0.32 | -0.43* | -0.26 | -0.10 | -0.03 | 0.04 | 0.26 | 0.42 | 0.56 | 0.38 | 0.56 | 0.32 | 0.23 | 0.24 | 0.69** |
| | (0.36) | (0.48) | (0.47) | (0.55) | (0.39) | (0.26) | (0.25) | (0.31) | (0.36) | (0.27) | (0.40) | (0.39) | (0.44) | (0.41) | (0.39) | (0.21) | (0.22) | (0.24) | (0.28) |
| MR_comlang | 0.52 | 0.60 | 0.63 | 0.93** | 1.02*** | 0.94*** | 0.78*** | 1.08*** | 0.71 | 0.30 | 0.34 | 0.55 | 0.37 | 0.63 | 0.60 | 0.78*** | 0.64** | 0.42 | 0.50 |
| | (0.70) | (0.78) | (0.67) | (0.38) | (0.27) | (0.24) | (0.21) | (0.37) | (0.45) | (0.44) | (0.61) | (0.53) | (0.61) | (0.62) | (0.67) | (0.30) | (0.30) | (0.34) | (0.34) |
| MR_west_to_east | 30.93** | 1.49 | -12.32 | -5.65 | -30.80*** | -28.33*** | -31.17*** | -21.81*** | -23.33*** | -16.87*** | -23.86*** | -19.82*** | -22.29*** | -19.57*** | -18.46*** | -11.98** | -8.57* | -5.29 | -8.26 |
| | (13.77) | (11.25) | (9.33) | (7.83) | (6.99) | (3.33) | (3.00) | (7.98) | (5.05) | (4.49) | (5.48) | (5.13) | (5.94) | (5.90) | (6.12) | (5.30) | (5.13) | (4.85) | (5.28) |
| MR_east_to_west | -28.93** | 2.43 | 14.63 | 4.07 | 30.65*** | 30.39*** | 33.60*** | 21.87*** | 22.65*** | 16.51*** | 24.01*** | 20.57*** | 22.73*** | 20.18*** | 19.18*** | 12.89** | 9.87* | 6.17 | 8.23 |
| | (12.81) | (10.79) | (9.06) | (7.90) | (7.06) | (3.22) | (2.90) | (7.89) | (4.86) | (4.19) | (5.45) | (5.27) | (6.11) | (6.08) | (6.35) | (5.36) | (5.32) | (4.96) | (5.50) |
| MR_EU | 2.01 | 4.61*** | 3.97*** | -1.16 | -0.56 | -0.65 | -0.20 | -0.43 | | | | | | | | | | | |
| | (2.37) | (1.63) | (1.02) | (2.23) | (1.48) | (1.40) | (1.37) | (1.60) | | | | | | | | | | | |
| MR_nonEUrta | 1.01 | 1.34* | 1.53*** | 0.13 | -1.80** | -2.25*** | -2.21*** | -1.52* | -3.10*** | -0.73 | 0.12 | | | | | | | | |
| | (1.77) | (0.72) | (0.50) | (2.39) | (0.73) | (0.60) | (0.57) | (0.82) | (1.19) | (1.40) | (1.36) | | | | | | | | |
| MR_landlock_imp | -13.75 | -71.62*** | -63.76*** | -25.51* | 36.48*** | 35.00*** | 32.55*** | 18.00** | 12.61*** | 12.90*** | 4.72 | 5.83 | 4.22 | -2.32 | 5.88 | 23.82*** | 17.15*** | 23.69*** | 16.89*** |
| | (19.88) | (14.11) | (10.50) | (15.42) | (9.12) | (6.88) | (5.76) | (8.95) | (4.22) | (4.70) | (5.59) | (4.21) | (6.20) | (6.10) | (8.04) | (4.53) | (4.84) | (5.09) | (5.50) |
| MR_landlock_exp | 6.71 | 10.27 | 12.44 | 17.08 | 12.76 | 16.65** | 14.61* | 10.31 | 12.23 | 9.39 | 5.53 | 10.10 | 12.64 | 17.60* | 21.06* | 14.36* | 12.95* | 12.51* | 9.87 |
| | (12.52) | (13.19) | (13.81) | (14.99) | (8.47) | (8.28) | (8.58) | (8.42) | (8.77) | (6.83) | (7.66) | (7.85) | (9.94) | (10.20) | (11.08) | (7.36) | (7.63) | (7.49) | (7.57) |
| MR_comcol | -20.21* | -6.81 | -2.13 | -0.78 | 1.26 | 1.99* | 1.58* | 2.74 | 3.67** | 2.89*** | 2.75*** | 4.56*** | 4.43*** | 4.73*** | 5.07*** | 6.62*** | 7.35*** | 6.45*** | 6.17*** |
| | (11.27) | (7.05) | (6.31) | (5.73) | (2.04) | (1.13) | (0.95) | (2.54) | (1.80) | (0.90) | (1.02) | (1.01) | (0.99) | (1.27) | (1.28) | (1.09) | (0.96) | (0.91) | (0.78) |
| MR_soc_bus_fnd | -0.23 | -0.08 | -0.33** | -0.35** | -0.16 | 0.01 | 0.02 | -0.26** | -0.26** | -0.11 | -0.19** | -0.22*** | -0.26** | -0.23*** | -0.18* | -0.11 | -0.16* | -0.10 | -0.11 |
| | (0.14) | (0.18) | (0.15) | (0.18) | (0.11) | (0.09) | (0.07) | (0.10) | (0.10) | (0.09) | (0.08) | (0.08) | (0.12) | (0.09) | (0.11) | (0.09) | (0.09) | (0.08) | (0.08) |
| MR_gov_fisc_fnd | -0.31** | -0.05 | -0.30* | -0.47*** | -0.34*** | -0.15** | -0.12* | -0.20* | -0.32*** | -0.35*** | -0.40*** | -0.27** | -0.29** | -0.25 | -0.34* | -0.04 | 0.07 | 0.07 | 0.30** |
| | (0.15) | (0.16) | (0.17) | (0.15) | (0.09) | (0.07) | (0.07) | (0.10) | (0.12) | (0.09) | (0.12) | (0.12) | (0.12) | (0.17) | (0.18) | (0.12) | (0.10) | (0.12) | (0.13) |
| MR_trade_fnd | 0.05 | -0.06 | 0.19 | 0.37 | -0.14 | -0.54** | -0.67*** | -0.39 | 0.18 | 0.27 | 0.12 | -0.02 | 0.40 | 0.11 | 0.28 | -0.84** | -0.81** | -0.67 | -0.94** |
| | (0.38) | (0.44) | (0.31) | (0.73) | (0.41) | (0.25) | (0.18) | (0.40) | (0.46) | (0.40) | (0.43) | (0.35) | (0.42) | (0.48) | (0.44) | (0.39) | (0.36) | (0.43) | (0.43) |
| Constant | -27.63 | 75.59* | 63.59* | 19.67 | -55.44*** | -31.58** | -29.78** | -51.87*** | -12.53 | 17.13 | 32.99 | -9.39 | -13.10 | 2.42 | -14.99 | -45.29** | -26.21 | -27.30 | -34.09 |
| | (52.45) | (43.74) | (32.63) | (35.47) | (20.52) | (15.29) | (14.94) | (19.96) | (20.81) | (21.50) | (24.87) | (24.26) | (27.44) | (31.43) | (37.46) | (21.01) | (24.49) | (22.37) | (24.38) |
| Observations | 650 | 650 | 650 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 | 702 |
| R-squared | 0.68 | 0.39 | 0.32 | 0.44 | 0.68 | 0.70 | 0.69 | 0.69 | 0.61 | 0.61 | 0.48 | 0.55 | 0.50 | 0.52 | 0.50 | 0.77 | 0.78 | 0.73 | 0.67 |
| Estimator | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML | PPML |
| Product Code | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |