The European Union and the Euro
A Gravity Approach on Bilateral Trade

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Abstract

In the year of 1999 a new monetary experiment commenced – the birth of the euro. Over the years more countries have joined the new currency and it was expected to be a continuously growing community. The purpose of this paper is to measure the effect of European membership, the currency of euro and the financial crisis on trade between the countries located in Europe. For the task of this paper the gravity model is used to study the bilateral trade flows in the European Union from 1995-2011. It additionally investigates, besides the correlation between GDP and distance, the effect of shared border, shared language and coastal access. The results showed that the euro did indeed have a positive impact on trade in the introduction year to later significantly have a negative impact on trade. Moreover, a membership in the European Union results showed to promote intra-European Union trade at the cost of extra-European Union trade and have its largest impact in the beginning and end of the study years. The conclusion is that other factors than increased trade were the main reasons to join the European Union, such as enhancing the role of Europe in the world market and to turn into a unified market. Finally, the effect of the financial crisis was found to have a negative impact on trade, concluded that it exposed the failures and lack of coordination between and within countries. It was also shown that the physical distance, and not specifically distances in i.e. social culture and languages, boosted the trade between countries.
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1. Introduction

‘The gravity model has become a favored tool to assess the ex-post trade effects of a currency union’ (Glick and Rose, 2002; Carrère, 2004, p.224)

The main goals with the foundation of the euro was “To enhance Europe’s role in the world monetary system” and “to turn the European Union into a truly unified market” Krugman and Obstfeld (2009) p.567. The collapse of the Bretton Woods system affected the confidence for the European community and it was said that they put their national interests ahead of their international monetary responsibilities. Thus the creation of a currency area would transfer the economic power from foremost the U.S. to the European community. Will the situation today end up as the Bretton Woods system or will it prove to be stronger? Moreover, the invention of the currency area would tighten the bonds between the historically war characterized countries. Thus increasing the communication and reduce the differences between the countries, and at the same time unify the market, would strengthen the European community as a whole.

The sovereign debt crisis in Europe year 2007 introduced a massive discussion regarding the actual welfare of the European Union. From being one of the new major economic forces in the world, the European Union is now being viewed to be an unstable monetary union, promoting trade between the countries but at the cost of each other economies where economic welfare is transferred. Countries such as Greece, Portugal and Spain are currently seeing themselves as exploited by the bigger economies; such as Germany and France. On the other hand, the bigger economies experience their role as ‘parenting’ and the will to support the lack of economic welfare in other countries grows weaker for every day. Questions regarding splitting the European Monetary Union into two, devaluation of the euro and instead of entering the European Union, leaving the European Union is now being considered to be a more rational solution to the problem.

The future of the European Union remains in the actions of today; will the image of the European Union grow stronger or weaker and will it consist of the same countries. The many divergences, historical and actual, between the countries fuels the politician fronts. The question whether the European Union would have been better off by only agreeing to a customs union and thus never approached the question about euro and whether the countries who have adapted the euro (see appendix 1 for which countries entered which year) should have been allowed into the monetary union in the first place arise. Will the lack of control and supervision of the countries in the early 21st century be the downfall of the currency union? There do exist major divergences in the economic welfare which should be investigated and accounted for; some countries might be too ‘strong’ compared to the other. “A country is more likely to benefit from joining a currency area if the area’s economy is closely integrated with its own. The overall degree of economic integration can be judged by looking at the integration of product markets... and at the integration of factor markets” Krugman and Obstfeld (2009) p.582.

This paper will, by the use of the gravity model, analyze the bilateral trade in terms of exports between the countries in Europe and test the significance of being a part of the European Union, adopting the currency of euro and the effect of the financial crisis. Moreover it will also test the significance of language (social divergence) which is defined by the history and also induces
an additional ‘cost’, border (physical distance) and coastal access on trade. Later on, a discussion regarding the findings and what the theory offers to the problem will be provided.

1.1 Previous Research

Studies and various reports regarding the significance of the European Union has had on trade are a fast-growing subject. Baldwin, Skudelny and Taglioni (2005) conducted a study regarding the impact of the European Monetary Union on trade, also referred to as the “Rose effect” (i.e. trade effects of a currency union). Considering a monopolistic competition market and the effect of exchange rate uncertainty they jointly measured the significance of the European Monetary Union and stated that the euro has had a positive effect on intra-EU trade, by approximately 5-10%. One year later Baldwin (2006) tested the “Rose effect” once again and found the same results.

Dee and Gali (2005) tested the effect of different preferential trading agreements around the world and whether they had any effect on trade and on foreign direct investment. Their findings were that the only effect the European Union had on trade was the boosting of intra-EU trade at the expense of non-members and otherwise failed to have an impact on trade in general.

Moreover, the divergences in Europe were suspected by Björksten and Syrjänen (1999) where they used a “convergence barometer” along with the Taylor rule based “monetary thermometer” to compare the different optimal policy for each individual country in the euro area. Their findings were that the policymakers should indeed be concerned about the divergences in Europe as the automatic stabilizers may not be enough alone to restore equilibrium in the market.

1.2 Disposition

The next chapter addresses the background and the purpose of the European Union as a currency union and a customs union, chapter 2, it further briefly discusses the issue of the sovereign-debt crisis in 2007 and what the reasonable solutions would have been if a currency union was not in place. Chapter 3 describes the effects of economic integration in terms of tariffs, comparative advantage and economies of scale. Chapter 4 approaches the theory behind the gravity model and recent developments.

Chapter 5 describes the choice of model, the variables of choice, descriptive statistics for the variables (given each and every year) and finally the results from the regressions. Chapter 6 contains the analyzing part of the results and chapter 7 contains the conclusions of the findings.
2. European Union

The beginning of the European Union, as we know it today, began 1992. “The Treaty on European Union (TEU) represents a new stage in European integration since it opens the way to political integration. It creates a European Union consisting of three pillars: the European Communities, Common Foreign and Security Policy (CFSP), and police and judicial cooperation in criminal matters (JHA). The Treaty introduces the concept of European citizenship, reinforces the powers of the European Parliament and launches economic and monetary union (EMU). Besides, the EEC becomes the European Community (EC).” The main objectives with this treaty was to “increase the influence of the democratic legislation of the institutions… establish the start of the economic and monetary union”. – Maastricht treaty, Europa-EU (2013)

Additionally to the common monetary goal throughout the union, a goal for removing trade barriers and creating a single market was initiated to be a customs union where trade and welfare are highly promoted. From the year 2005 to 2010 the total value of intra-EU trade by the EU-27 members increased by 19.1% according to a report made by Eurostat (2012), implying increased economies of scale and the benefits of comparative advantage. This can be explained by the growing countries, in terms of population and GDP, reduced bilateral trade barriers between the countries and a continuously integrating society throughout the European Union.

However, the countries in Europe might have too large diversities – making it hard to obtain a monetary policy which suits every country. Thus this might lead to bias in the policy making. Germany, with the largest GDP and an export biased industry, influence the decision-making regarding the monetary approach in Europe. And as they are known historically and currently to be very inflation hostile the outcome of the common policy tends to be highly influenced by the policy of Germany. This in turn restricts many of the otherwise potential monetary policies the European Central Bank could approach to solve the sovereign-debt crisis in Europe.

The European sovereign-debt crisis inflicted a high amount of debt for the PIIGS countries. “It is obviously true that, for any given balance-of-payments deficit, a sufficient contraction of the money stock will restore the external balance… It is equally true that this result could be achieved by tight fiscal policy, and so there is nothing especially monetary about this interpretation of remedies for external balance” Dornbusch, Fischer and Startz (2011) p.531. Thus, as the option of contractionary monetary policy ceased to exist when they adopted the euro; left is contractionary fiscal policy, which has been observed to take place in these countries. However, the process is long and has resulted in an increase of unemployment, decreased government sector spending (pension, police, hospital…) which in turn have, as observed lately, resulted in a strong public reaction.

Additionally, a solution including a contractionary monetary approach is highly ineffective, as the euro is to be considered, due to the amount of countries it has to consider. Those who would consider a contractionary monetary policy lose the option of devaluation to strengthen their

---

1 All members and their year of entrance can be found in appendices. Appendix 2.
2 Historical data regarding Germany’s inflation can be found in appendices. Appendix 3.
3 PIIGS = Portugal, Ireland, Italy, Greece and Spain.
economy due to the entrance of the European Monetary Union. “Devaluation therefore causes a rise in output, a rise in official reserves and an expansion of the money supply.... It allows the government to fight domestic unemployment despite the lack of effective monetary policy... Improvement in the current account and finally a positive effect on the central bank’s foreign reserves” Krugman and Obstfeld (2009) p.473. An optimal recovery for the affected countries thus lies in the combination of contractionary fiscal and monetary policy but is as mentioned restricted.

Moreover, Ahearne and Pisani-Ferry (2006) addressed the issues of having too large diversities among the economies in the European Union. They approached this issue by taking the expected export growth, change in real exchange rate, domestic demand and the current account dispersion for the biggest countries in the European Union (in terms of GDP) into account. Their conclusions were that the diversity between the countries tends to favor, in terms of GDP, the strong countries and disfavor the weak ones. Hence this may be an indication that the countries in the European Union are not that equal after all. “... Asymmetric economic developments within different countries of the euro zone... will be hard to handle through monetary policy... And would likely lead to political pressures on the European Central Bank” Krugman and Obstfeld (2009) p.587. This type of transfer of economic welfare has been observed to be disapproved by the stronger countries (Finland, Germany…), especially as the European Monetary Union is young and already experience problems. A relationship as observed between the European countries tend to create a ‘fiscal federalism’ (economic resources transferred from healthy to suffering economies) due to the loss of economic stability of fixed exchange rates between the EMU countries.

### 2.1 European Economic Overview

The European and world market are continuously moving into integration and with it the total trade flows steadily increasing with time. According to Eurostat (2013) EU-27 registered, externally, both a higher export as well as import flows, see figure 2.1.1, compared to the G-20 countries. In 2011 the European countries experienced a trade deficit equal to EUR 155.8 billion, only second in the world to the U.S. with a EUR 563.8 billion trade deficit. The global financial crisis effects did also affect other large trade economies, such as China. However, the effects China encountered were smaller than the one the U.S. and the European Community experienced. Hence economies located as far as the other side of the world are now also affected by the events in the western world – a result from economic integration.

![Figure 2.1.1. Exports and Imports by EU-27 Compared to Other Economic Forces.](image)
In January 2013 Eurostat reported that the foreign direct investment by EU27 in investment stocks in the rest of the world had increased by 50%, accounting to EUR 4983 billion from year 2008 to 2011. The FDI’s increase began to show signs of recovery from the financial crisis (see figure 2.1.2). However, the amount of foreign direct investment in EU27 by the end of year 2011 accounted to EUR 3807 billion – implying that the European Community is a net investor in the rest of the world. Within Europe, regarding the countries that are not a part of the European Community, the largest investments by far were made in Switzerland (EUR 598.2 billion in year 2011) meanwhile Russia was positioned as second with EUR 166.8 billion. The only country which had a higher foreign direct investment by the EU27 compared to Switzerland was the U.S. with a total of EUR 1421 billion.

![Figure 2.1.2. Foreign Direct Investment by EU27](image)

After one month since the FDI report had been officially reported, the report regarding EU27’s growth rate came. During year 2012 it would have seemed that the negative trend of GDP tended to smooth out. However, the report for the fourth quarter showed that the negative trend would continue as the growth rate fell by 0.6% in the euro area and by 0.5% in EU27. Compared to the fourth quarter year 2011 the growth rate dropped by 0.9% and 0.6% respectively (see figure 2.1.3). Meanwhile EU27 experienced a continued negative trend in GDP, the U.S. had an increase in GDP by 1.5% compared to the same quarter in the previous year.

![Figure 2.1.3. GDP Growth Rate of EU27, EU17 and the U.S.](image)

Source: Eurostat, 2013
3. Theory

One of the main barrier to trade is the effect of a tariff. However, the effect of a customs union is to establish an agreement on tariffs (the countries agree on the same amount of the tariff or to abolish the tariff completely) between the countries which are a part of the union. The preferential trading agreement in the European Union thus increases the price for products which are imported from outside the European Union. Hence it is more preferable for these countries to trade with each other and less with countries not part of the European Union. Without the preferential trading agreement then when a good is to be exported it is only to pay a certain fee when crossing the border of the union and then be allowed to freely move between the countries.

Moreover, an integrated market allows broader trade and specialization in goods. “International trade allows creation of an integrated market that is larger than any one country’s market, and thus makes it possible simultaneously to offer consumers a greater variety and lower prices” Krugman and Obstfeld (2009). Comparative advantage and economies of scale are two concepts which are going to be approached during this section; both increasing trade between countries.

3.1 Tariffs

A tariff consists of an additional cost of importing a good to a country. It can also be seen as an additional transportation cost, as Krugman and Obstfeld (2009 p.185) states. A tariff thus drives the price up of the good in the home “less than the amount of the tariff, because part of the tariff is reflected in a decline in foreign’s export price and thus not passed on to home’s consumers”.

![Figure 3.1. An Increase in Tariffs and Its Effects on Home-, World- and Foreign Market.](image)


By looking at figure 3.1, without any tariff the price would equal $P_w$ in all of the three markets above. Foreign is not willing to ship the good to the home market until the price difference between the foreign and home market equals at least the amount of the tariff.
The home market thus experiences a higher price due to the decrease in volume traded. If the country is relatively small the price in the world market remains approximately the same meanwhile the price in the foreign market, the far right, decreases.

### 3.2 Comparative Advantages

The original idea that countries benefit from trade came from Adam Smith (1776), however two major theories has developed since then. One of them, David Ricardo (1817) addressed and constructed the theory of comparative advantage and absolute advantage. “Trade between two countries can benefit both countries if each country exports the goods in which it has a comparative advantage” Krugman and Obstfeld (2009) p.29. The main idea of comparative advantages have its roots in the term opportunity cost which describes the cost of an activity in terms of another. This may be due to environmental, historical, educational reasons and further.

Absolute advantage occurs if country A can develop more of goods X and Y than country B. However, the labor in country A can either produce 100 X or 60 Y with its labors meanwhile country B can create 70 X or 50 Y. Country A, in this example, have an opportunity cost of producing 1 of good Y instead of 1.66 of good X, meanwhile country B have an opportunity cost of producing 1 of good Y at the cost of 1.4 of good X. Hence, even if country A has an absolute advantage of both goods, it only has the comparative advantage in good X and country B in good Y.

Thus specialization in the good where the country have a comparative advantage would lead to i) a bigger output and ii) economies of scale. This in turn leads to a higher standard of living in both of the countries. Applying this model to a free trade agreement union, as the European Union, leads to a higher welfare in all of the countries as well as a bigger economy.

### 3.3 Economies of Scale

The discussion regarding comparative advantages in countries tend to result in specialization. Specialization in countries in turn leads to another effect of the growing markets of the European Union - the economies of scale (increasing returns of scale). The effect of economies of scale increases the output and lowers the average cost of producing an additional good. From firms being perfectly competitive, the market structure changes to imperfect competition; where firms tend to grow larger and have a larger impact on the market of the good.

The effect of a larger market and specialization decreases the price of producing an additional unit, which in turn increases the total output (and total monopolistic variety of the good). The same effect occurs where there is an imperfect competition. The average cost decreases with the quantity produced.

![Figure 3.2. External Economies. As the number of firms increases the output follows the same pattern – leading to a lower price of the good.](image-url)
There are two major types of economies of scale. Krugman and Obstfeld (2009) explains external economies of scale as when an industry, and not necessarily a specific firm, gains a lower unit cost of producing an additional unit of good. Hence, the industry (all the firms) gains from clustering as can be seen in figure 3.2. This type of economies of scale tend to increase the knowledge spillover between industries and firms (gaining efficiency from information), develop specialized suppliers (unique goods and services) and finally a labor market pooling (labor concentrating in the areas where jobs (firms) exists. This would in turn lead to an increase in the total amount available as well as the variety of the labor). Purely external economies of scale in markets tend to result in perfect competitive markets – where many small firms exists and are price takers.

The other major theory regarding economies of scale is internal economies of scale. Krugman and Obstfeld (2009) explains this as when an individual or group of firms gains a lower unit cost of producing an additional unit of good. Thus, when the firm(s) expand their output they gain lower costs. Purely internal economies of scale tend to develop markets into imperfect competitive markets where the firms are few, large and are price setters. Hence this type of economies of scale tend to develop a monopolistic/oligopolistic behavior where the marginal cost decreases with the output.

### 3.4 Optimum Integration

The question whether the diversities between the European Union are indeed too large, as Ahearne and Pisani-Ferry (2006) reported, is still to be investigated. The GG-LL model used in Krugman and Obstfeld (2009) is used to provide an overview of the positive and negative aspect from joining a currency union and is shown in figure 3.4.1.

![The GG-LL model](image)

**Figure 3.3 The GG-LL model. Measuring Optimal Integration.**

Source: Krugman and Obstfeld (2009), p.579
The GG schedule is determined by the economic interaction between the country and the union, and the monetary efficiency gain from joining (i.e. avoiding uncertainty and transaction loss). The LL schedule represents the economic stability loss from joining a fixed exchange area and the degree of economic interaction. Additionally, the monetary efficiency gain would induce a lower interaction cost between the parties. “When the exchange rate is fixed, purposeful stabilization is more difficult because monetary policy has no power at all to affect domestic output” Krugman and Obstfeld (2009). Recall chapter 2 where a brief discussion regarding a contractionary monetary approach would be suitable, this theory is an interesting fact which is actual for the high current account-deficit countries. Without any speculations regarding this matter, it is worth mentioning that this is a subject that requires a lot of attention.
4. Model

The following equation [4.1] is known as the gravity model of (world) trade. It originates from Newton’s law of gravity and states that “as the gravitational attraction between any two objects is proportional to the product of their masses and diminishes with distance, the trade between any two countries is, other things equal, proportional to the product of their GDPs and diminishes with distance” Krugman, Obstfeld and Melitz (2012) (p.43). The trade between countries is higher if they are located closer to each other. Hence, according to theory, the loss in terms of volume of trade for the European Union would only diminish proportionally to the amount of the country which it supplied as the geographical distance would not change. However, the results may vary due to the definition of the term ‘distance’ which will be addressed later on.

\[ T_{ij} = A \times Y_i \times Y_j / D_{ij} \]  \[4.1\]

Hence, the explanatory variables are the GDPs of the countries and the distance between them. Large economies also mean a high comparative advantage, broad variety of products and high domestic demand; both for domestic products and imported products. The dependent variable T stands for the trade flows between the two countries.

The following model [4.2] was later used by Jan Tinbergen (1962) whereas he assumed 4 conditions for free trade between countries; 1, Temporary subsidies are to be given to infant industries 2, the subsidies are to be given only to the vital industries 3, the income within and amongst the countries are distributed and 4, the labor is educated for new technologies and capital is shifted from old to new industries.

\[ E_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \] \[4.2\]

The export from country i to j is represented by E. \( \alpha_0 \) is a constant, Y is the GDP of country i and j respectively and D represents the distance between them. He later used a logarithmic version of the model [4.3] for estimation purposes as it is non-linear. The model [4, 3] was used by Tinbergen (1962) for analyzes of trade flows by different countries.

\[ Ln E_{ij} = \beta_1 ln Y_i + \beta_2 ln Y_j + \beta_3 ln D_{ij} + ln \beta_0 \] \[4.3\]

Tinbergen (1962) later also took three types of dummy variables into his model, namely 1, if the countries where neighbors by border 2, a British Commonwealth preference and lastly 3, Benelux preference. However, only one of these variables, namely the commonwealth, proved to be significant for the study.

The gravity model has proved to be significant in the empirical studies, but has however only in the recent years developed a theoretical part. Andersson (1979) was the first one to address the theoretical framework and stated that trade between two countries is diminishing due to bilateral trade barriers, also known as “multilateral resistance”. Linnemann (1966) wrote about his interpretation of trade resistance, namely the natural and the artificial obstacles for trade. With natural obstacles he addresses the cost of transportation, in terms of time and the psychical distance between the countries. Moreover, factors as language, sociological, cultural and psychological differences between the countries are taken into account under natural
obstacles. Moreover, the term artificial obstacles include trade restrictions such as tariffs and quotas between the countries.

Linnemann (1966) developed a gravity model and introduced additional variables to the model. He stated that trade exists because domestic demand differs from domestic production. The option of changing the domestic production to match the demand would not be realistic; due to comparative advantages and economies of scale. The model \( [4.4] \) Linnemann used is as follows:

\[
X_{ij} = \delta_0 Y_i^{\delta_1} Y_j^{\delta_3} P_{ij}^{\delta_6} / N_i^{\delta_2} N_j^{\delta_4} D_{ij}^{\delta_5} \quad [4.4]
\]

Where \( X \) stands for exports from country \( i \) to country \( j \), \( Y \) for the GDP of respectively country, \( P \) for preferential trading agreement (dummy), \( N \) for population sizes for each country respectively and finally \( D \) for the geographical distance between the two countries. Linnemann also considered to add the variable of GDP per capita of each country but he found that this would induce problems with multicollinearity with the population variable and the GDP variable. Moreover, another viable considered was the land area. However, he found that the land area consists itself of natural resources which were traded, that people tend to agglomerate close to the natural resources (thus add multicollinearity between the variable and population) and finally that the size of the land area does not necessarily correlate with the natural resources.

\[
\ln X_{ij} = \ln \delta_0 + \delta_1 \ln Y_i + \delta_2 \ln N_i + \delta_3 \ln Y_j + \delta_4 \ln N_j + \delta_5 \ln D_{ij} + \delta_6 \ln P_{ij} \quad [4.5]
\]

The model \( [4.4] \) was then made logarithmic \( [4.5] \) for empirical purposes and used for data from 1959, consisting of 80 countries. He found that all of the variables are significant and that they gave the expected results where GDP had a positive impact on trade, population negative, distance negative and finally a positive effect from the preferential trading agreement.

### 4.1 Theoretical Foundation

The lack of the theoretical foundation has thus two major implications when using the gravity equation. “First, estimation results are biased due to omitted variables. Second, and perhaps even more important, one cannot conduct comparative statics exercises even though this is generally the purpose of estimating gravity equation” Andersson and van Wincoop (2003) (p.170). They continue to mention the econometric specification of the gravity model and state that it creates a bias in the evaluations of the effects from Regional trade agreements on bilateral trade, due to the lack of country specific effects.

However, Frankel (1998) does not agree with the statement that the gravity equation lacks a theoretical foundation; “It is certainly no longer true that the gravity equation is without a theoretical basis, since several of the same authors who noted its absence went on to provide one”. He then further develops his statement that authors have approached the gravity model using Coub-Douglas preferences and constant-elasticity-of-substitution (Anderson 1979), Heckscher-Ohlin preferences (Leamer 1974) and finally Dixit-Stiglitz preferences (Bergstrand 1989, 1990). Leamer (1974) did not however integrate the Heckscher-Ohlin preferences with the gravity model when motivating the explanatory variables, which Frankel (1998) attempted to address. However, the main issue with Heckscher-Ohlin model and the gravity model is that the gravity model has positive transportation costs and as no two
countries with the same factor price would induce trade with each other. Thus the producers on the foreign market could never compete with the domestic producers.

4.2 Further Developments

Another issue that may arise when constructing the barriers to trade function is biased estimators. McCallum (1995) experienced this problem when dealing with home country bias in the goods market. By the use of data of each province and state in Canada and the U.S. he found that trade was expected to be 20 times bigger between two provinces in Canada compared to the trade between a province in Canada and a state in the U.S; even if a province and a state had more in common. Andersson and van Wincoop (2001) tested his findings and found that the trade was indeed larger between provinces, however not as large as McCallum estimated. They argued that this was due to the reason that McCallum had not used proper bilateral trade resistance variances and thus had biased border effect results.

The approach used by Andersson and van Wincoop (2003) is to combine the regional dummies for each country pair and turn these values, along with the distance, to a “multilateral resistance term”; used to control the dummy estimators that influenced the bilateral trade. Another method was also used by Rose and Van Wincoop (2001), namely country fixed effects. This method treats the observed dependent variables as if they were non-random – instead of random effects models and mixed models. Both of these methods gives estimates which can be used in the gravity model (see Andersson and Van Wincoop (2003)). This use of the gravity model are only relevant in cross-section data where time-dimensions are not included. Thus, by the use of i.e. a dummy variable for the European sovereign-debt crisis; the dummy would prove to be significant if the whole panel data was to be considered and tested. Another way to approach the data used by Céline Carrère (2006) is the procedure of the ‘Within equation’, however this method treats the bilateral effects as fixed and thus remove any issue of biased estimators. But as the data consists of time-dimensions the estimators would only be proved to be significant whenever a change in the time period is made. Hence the significance of a membership in the European Union would be lost. Moreover is that the ‘Within equation’ ignores cross-sectional data and this would in turn remove the desired interpretation of the dummy coefficients.

Additionally the dummy variable would prove to be not significant if being considered year for year. As the purpose is not to compare the standards or 'means' of the bilateral trade between countries and rather test the significance of the variables 'leaving the euro' and 'leaving the EU', the former method is going to be further investigated.

The “multilateral resistance term” between two countries, \( \theta_{ij} \), used by Andersson and Van Wincoop (2003) contains the 'barriers to trade' variables. It is stated as follows:

\[
\theta_{ij} = (D_{ij})^{\delta_1} \times (IN_i)^{\delta_2} \times (IN_j)^{\delta_3} \times [e^{\delta_4 L_{ij}^{\delta_5} + \delta_6 E_i + \delta_6 E_j}]
\]

The variables, and expected signs, are as follows:

- \( D_{ij} \): The distance between country i and country j (\( \delta_1 > 0 \))
- \( L_{ij} \): Equals 1 if country i and j shares a border, otherwise 0 (\( \delta_4 < 0 \))
- \( E_{(ij)} \): Equals 1 if the country i (j) is landlocked, otherwise 0 (\( \delta_5 > 0, \delta_6 > 0 \));
$IN_{i0j}$: Computed as an average of the density of road, railway and the number of telephone lines per capita - level of infrastructure of the country $i$ ($j$) ($\delta_2<0, \delta_3<0$).

The multilateral resistance term thus gives an estimation containing the 'barriers to trade' variables. However, by the use of this method the individual significance for each and every dummy variable (as well as the distance variable) will be lost. This way it will be more difficult to observe the impact of the currency of euro as well as the impact on trade from entering the European Union.
5. Empirical Section

5.1 Model of Choice and Variables

The gravity model was indeed intended to be used in this paper. However, there are many variants in how to define the variables as well as the equation itself. Andersson and van Wincoop (2003) choice of multilateral resistance term did sound appealing but as stated above; a grouped variable will be achieved and thus it will be hard to observe the significance of each and every variable. Thus the more original option of Linnemann will be used where the model later will be double logarithmic for estimation purposes. Linnemann did reject the choice of introducing GDP per Capita into the model due to multicollinearity; thus a correlation matrix, appendix 4, was computed as there were suspicions regarding the correlation between the variables GDP and population. Indeed the correlation matrix showed that the variables were highly correlated depending on the year; between 81%-85%. Hence the variable population was removed and the model was modified to include Tinbergen’s model [4.3] where the GDP for each country was used along with the distance variable.

Two regressions will be run to have sufficient information regarding the coefficients and their estimators. The first regression model [5.1] will include all 29 countries for each year in the time period 1995-2011 but divide the years into 3 sets; 1995-2000, 2001-2006 and 2007-2011.

\[ \text{LnExp}_{ij} = \beta_0 + \beta_1 \text{Ln}Y_i + \beta_2 \text{Ln}Y_j + \beta_3 \text{Ln}D_{ij} + \beta_4 \text{Lan} + \beta_5 \text{Bor} + \beta_6 \text{Cur} + \beta_7 \text{LockExp} + \beta_8 \text{LockImp} + \beta_9 \text{EuExp} + \beta_{10} \text{EuImp} + \epsilon_{ij} \]  

[5.1]

The second regression model [5.2] will include all 29 countries in the time period 1995-2011 and will calculate the impact of the sovereign debt crisis on the trade in the European Union. The variable will start taking effect the year 2007. Additionally, dummies are introduced for each and every year to allow for a different intercept in each year. As a result, the dummy coefficient of each year will generate the mean traded value in each year. To avoid the dummy variable trap the intercept term is omitted.

\[ \text{LnExp}_{ij} = \beta_0 + \beta_1 \text{Ln}Y_i + \beta_2 \text{Ln}Y_j + \beta_3 \text{Ln}D_{ij} + \beta_4 \text{Lan} + \beta_5 \text{Bor} + \beta_6 \text{Cur} + \beta_7 \text{LockExp} + \beta_8 \text{LockImp} + \beta_9 \text{EuExp} + \beta_{10} \text{EuImp} + \beta_{11} \text{EuCrisis} + \beta_{12} \text{Year (1996, 1997, ..., 2011)} + \epsilon_{ij} \]  

[5.2]

The variables which will be used in the regressions will now be presented, along with their sources and the expected signs. A table will then be presented summarizing the hypothesis.

Total Export Value (LnExp\(_{ij}\))
This variable contains the export data from country i to country j (the other 28 countries) for each and every year. This is the dependent variable in both of the regression models and was collected from Comtrade. The values was measured in current US dollars and then made logarithmic.

The GDP of the Exporting Country (Ln\(Y_i\))
This explanatory variable consists of the reported GDP of country i for each and every year and is measured in current US dollars. It was collected from UNdata base and should have a large positive impact on trade according to Linnemann (1966), Tinbergen (1962) and the main concept of Newton’s gravity model. As this variable increases, the more products will be available for exports.
The GDP of the Importing country \((LnY_j)\)
This explanatory variable was collected, reported and measured in the same way as the previous. This variable should as well have a large impact on trade according to Linnemann (1966), Tinbergen (1962) and the main concept of Newton’s gravity model. Additionally, Linnemann (1966) describes this variable as the ‘attraction’ variable as with an increased size the domestic demand will increase along with domestic income. Thus increasing the total amount imported from country \(i\).

Geographical Distance \((LnD_{ij})\)
This explanatory variable was collected from geobytes.com and contains the geographical distance between the capitals for each and every country in the study. As Newton’s gravity model as well as Linnemann (1966) states, this variable should have the largest negative impact on trade. The trade between two countries diminishes as the distance increases. This variable was measured in kilometers and then made logarithmic. The cities used for measuring the distance can be found in appendix 5.

Common Currency \((Cur)\)
This dummy variable was collected from Nationalencyklopedin and takes on the value of 1 if, and only if, country \(i\) and country \(j\) shares the same currency, otherwise 0. Sharing the same currency would induce a decreased distance between the objects (countries). Thus, as decreased distance increases the trade between the countries this variable would have a positive impact on trade according to Linnemann (1966).

Exporting Country in the European Union \((EuExp)\)
This dummy variable takes on the value of 1 if, and only if, the exporting country is a part of the European Union, otherwise 0. According to Krugman and Obstfeld (2009) the economic integration would have a positive impact on trade due to comparative advantage and economies of scale. Due to these reasons along with being a customs union (where tariffs are less or removed for trade between the countries) this variable should have a positive impact on trade.

Importing Country in the European Union \((EuImp)\)
This dummy variable takes on the value of 1 if, and only if, the importing country is part of the European Union. This variable should as the variable above have a positive impact on trade. And due to the preferential trading agreements countries are more willing to trade with other countries that are part of the European Union as well. Thus the trade flows would decrease if destined to a country part of the European Union, if the exporting country is not part of the customs union as well, which in turn implies tariffs, higher costs and lower demand (Krugman and Obstfeld, 2009). Hence it is hard to predict a hypothesized effect of this variable.

European Sovereign Debt Crisis \((EuCrisis)\)
This dummy variable takes on the value of 1 if, and only if, the economic crisis is in effect. This variable start having an effect from year 2007 until 2011 and will capture the effect of the sovereign debt crisis in Europe. This variable should have a negative impact on trade.

Common Language \((Lan)\)
This dummy variable was collected from Nationalencyklopedin and takes on the value of 1 if country \(i\) and country \(j\) shares the same language, otherwise 0. According to Linnemann (1966) this is a natural barrier to trade (included in distance) and thus sharing the same language should have positive impact to trade.
Common Border \((Bor)\)
This dummy variable was collected from WorldAtlas and takes on the value 1 if and only if country \(i\) and country \(j\) shares a land border with each other, otherwise 0. However, if two countries are connected by an artificial construction (such as the Sweden-Denmark Bridge or UK-France tunnel) the value will be given 1. This is due to the reason that this transportation way does not require a shift of vehicle (i.e. truck-boat) in the transportation. Thus this new connection does not induce a major increase of transportation time. This variable should, if given value 1, have a positive impact on trade as sharing a common border naturally decreases the distance between countries compared to if they did not share a border as Linnemann (1966) argues.

Landlocked Exporter \((LockExp)\)
This dummy variable was collected from WorldAtlas and takes on the value of 1 if, and only if, country \(i\) has access to the coast. According to Brakman, Garretsen and van Marrewijk (2009) this variable induces less transportation costs and less delays. However, this variable importance has declined through time as new transportation systems have developed – allowing a less costly and a more efficient way for transportation. Countries which have had access to the coast have improved this transportation system as well. On the other hand, countries located centrally in Europe such as Switzerland has no access to coast but do have a central geographical location close to big economies such as Germany and France. Thus the geographical location importance may overcome the significance of access to a coast. This variable should have a slightly positive effect on trade.

Landlocked Importer \((LockImp)\)
This dummy was collected and reported in the same way as the variable above. It takes on the value 1 if, and only if, the importing country has access to a coast, otherwise 0. Due to the same reasons above, this variable should have a slightly positive effect on trade.

Year Dummies \((Year)\)
This dummy variable is introduced to generate an intercept for each and every year. This is due to the reason that GDP and the exports contains continuous data and to investigate whether there is a yearly effect in a given year. Thus the value of 1 is given if, and only if, the year is of relevant interest. Otherwise 0. As trade can return both a positive, insignificant and negative mean value (compared to the benchmark year), this variable is hard to put a trend on (Gujuratı and Porter, 2009).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypothesized Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP(_i)</td>
<td>Positive</td>
</tr>
<tr>
<td>GDP(_j)</td>
<td>Positive</td>
</tr>
<tr>
<td>Distance</td>
<td>Negative</td>
</tr>
<tr>
<td>Common Currency</td>
<td>Positive</td>
</tr>
<tr>
<td>EU Exporter</td>
<td>Positive</td>
</tr>
<tr>
<td>EU Importer</td>
<td>Ambiguous</td>
</tr>
<tr>
<td>EUcrisis</td>
<td>Negative</td>
</tr>
<tr>
<td>Landlocked Importer</td>
<td>Positive</td>
</tr>
<tr>
<td>Landlocked Exporter</td>
<td>Positive</td>
</tr>
<tr>
<td>Common Border</td>
<td>Positive</td>
</tr>
<tr>
<td>Common Language</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Table 5.1.3. Hypothesized Effect of the Variables.
5.1.1 Additional Assumptions

During the information retrieval it became clear that much data was not available for certain years. Additionally, Belgium and Luxembourg separated the year 1999 and was before that one single country. It was possible to include Belgium-Luxembourg in the studies but this would have induced problems with the choice of capital and thus the distance. Hence Belgium and Luxembourg enters the sample year 1999 and is not accounted for until then. The missing values as well as the zero-trade flows, mostly found during the 20th century, can be dealt with by three different guides the World Trade Organization (2012) offers.

The first way is to drop the observation with a zero-trade flow. This can be done if the zero-trade flows are randomly distributed and thus are not informative. The second way to approach this problem is the use of adding a small constant instead of the zero-trade flow. This method is of importance when small economies, such as Malta, chooses not to commit any trade due to distance, land locked reasons or excessive transportation costs. This has also been observed to be the case with Malta and Cyprus. The third way to approach the problem is the use of estimating the model in levels where each and every variable is estimated. This approach would induce a non-linear relationship.

The second and third way is incorrect if the OLS estimation method is used. If the second or third method were to be used inconsistent estimators in the results would have been obtained. “Second, the use of OLS estimation in levels is not supported by theoretically founded gravity equations that present a multiplicative form” WTO (2012).

Thus, even though many of the observations with a zero-trade flow can be considered random, the use of the first method is forced to be conducted with the remaining observations where transportation cost and distance might have been the case. The observations with zero-trade flows are thus considered to be random and removed.

5.2 Method

The first regression will deal with the data in three sets, cross-sectional data for the years 1995-2011, by the use of ordinary least squares (OLS). This way the trend which the estimators are changing can be more specifically observed. The second regression will pool the data and, by the use of OLS once again, construct one regression instead of 17. This is the regression which will estimate the effect of the sovereign debt crisis in Europe with the start of 2007 and also create an intercept for each and every year (year dummies).

To remove cross-sectional correlation between the variables in the time trend, referred to as ‘Gold medal error’ in the paper written by Baldwin and Taglioni (2006), time invariant pair dummies can be created to be used in the pooled data for the second regression. This type of procedure is referred to as ‘The Fixed Effect Least-Squares Dummy Variable Model (LSDV)’. Gujurati and Porter (2009) state that this type of procedure requires many dummy variables in the model, and as the model already consists of a significant amount of dummy variables, introducing additional dummies would result in a higher possibility of multicollinearity. Additionally, as there exists variables that does not change with time (such as coastal access and partly language), “In some situations the LSDV may not be able to identify the impact of time-invariant variables... Incidentally, the time-invariant variables are
sometimes called nuisance or lurking variables”, Gujurati and Porter (2009) p.598. Hence, this approach is disregarded.

It is also given naturally that due to the different sizes in GDP between the countries the variance in the exports cannot be the same (Gujurati and Porter, 2009). Additionally, due to the reason of the amount of dummy variables the variances are not expected to be equal. This can be explained by that each and every dummy variable measures different subjects and where the effect of one dummy variable can equal in more zeros meanwhile the other equals in more ones (Aczel and Sounderpandian, 2009).

White’s General Heteroscedasticity Test was conducted on the data and the plots of residuals against the predicted values can be found in appendix 6. It became evident that there was heteroscedasticity present in the data and the presence of heteroscedasticity makes the estimators inefficient, underestimate/overestimate the variances and therefore may cause the regression results to be misleading (Gujurati and Porter, 2009). Thus to remedy this problem the use of White’s heteroscedasticity-consistent standard errors are generated and replaced the regular standard errors generated from the OLS regressions.

5.3 Descriptive Statistics

The descriptive statistics can be found in table 5.3.1 and table 5.3.2 for the first and the last year, 1995 and 2011. The dependent variable, LnExp, increased by 0.6734 in the mean and by 0.6368 in the median. Indicating that the trade flows has increased on average but in the same time the central point has increased less and also stating that on average the bigger economies have increased their exports more than the smaller. This can also be verified by the values of GDP for the exporting countries as well as the importing countries where the mean has increased more than the median. However, many observations 1995 were missing and if these values corresponds to smaller countries then these results could be explained by the fact that even though the trade flows have increased – the new data from the former missing countries may have had an effect on the median as well as the mean. The standard error has decreased in value from the observation in 1995 to 2011 indicating that the most values have clustered in the middle.

The dummy variable for currency has increased to count for 33% of the countries conducting bilateral trade flows in year 2011. This is to be expected as the euro was introduced year 1999 and thus its impact is not to be significant before that. The variable counting for if the exporting respectively the importing country were a part in the European Union differs year 1995, and then both increases to account for 93% of the bilateral trade flow. The difference 1995 can be explained by the missing observation that were removed meanwhile the increase from 1995 to 2011 is to be expected as only Norway and Switzerland were not a part of the European Union 2011.

The explanatory variable LnDist’s maximum and minimum remains unchanged meanwhile mean and median have decreased, implying that either more trade has been done to countries located closer or that the missing values from 1995 were countries closer located in Europe and thus effecting the result.

The GDP for the exporting and importing countries remains closely to each other for both year 1995 as well as year 2011. The standard deviation has, however, decreased from year
1995 to year 2011; implying that the distance from the mean value has decreased in year 2011 and that the values are more clustered in the middle than before.

The dummy variable for border countries remained the same, which was to be expected or even an increase as Belgium and Luxembourg (bordered countries) came into the sample first 1999. The dummy variables for if the countries were landlocked or not, where the value of 1 was given if they had access to a coast, differs a bit year 1995 meanwhile they are the same year 2011. The difference year 1995 would most likely be due to the missing observations that were removed. The final dummy variable, for language, increases from year 1995 to year 2011. This is to be expected as Belgium and Luxembourg came into the equation 1999 where both of the country’s official language are shared by others.
### Table 5.3.1 Descriptive Statistics for 1995

<table>
<thead>
<tr>
<th></th>
<th>LnExports</th>
<th>LnDistance</th>
<th>LnGDP Exp</th>
<th>LnGDP Imp</th>
<th>Currency</th>
<th>Border</th>
<th>Landlocked Exporter</th>
<th>Landlocked Importer</th>
<th>Exporter in EU</th>
<th>Importer in EU</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>8,1265</td>
<td>3,0902</td>
<td>10,9801</td>
<td>10,9456</td>
<td>-</td>
<td>0,11</td>
<td>0,81</td>
<td>0,82</td>
<td>0,5</td>
<td>0,48</td>
<td>0,03</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>8,2101</td>
<td>3,1229</td>
<td>11,1166</td>
<td>11,1157</td>
<td>-</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Std. Dev.</strong></td>
<td>1,2187</td>
<td>0,2730</td>
<td>11,8013</td>
<td>0,8030</td>
<td>-</td>
<td>0,309</td>
<td>0,394</td>
<td>0,389</td>
<td>0,5</td>
<td>0,5</td>
<td>0,17</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>3,0538</td>
<td>1,7404</td>
<td>9,5532</td>
<td>9,5532</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>10,7879</td>
<td>3,5760</td>
<td>12,4019</td>
<td>12,4019</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Counts</strong></td>
<td>676</td>
<td>676</td>
<td>676</td>
<td>676</td>
<td>-</td>
<td>676</td>
<td>676</td>
<td>676</td>
<td>676</td>
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<td>676</td>
</tr>
</tbody>
</table>

**Table 5.3.2 Descriptive Statistics for 2011**

<table>
<thead>
<tr>
<th></th>
<th>LnExports</th>
<th>LnDistance</th>
<th>LnGDP Exp</th>
<th>LnGDP Imp</th>
<th>Currency</th>
<th>Border</th>
<th>Landlocked Exporter</th>
<th>Landlocked Importer</th>
<th>Exporter in EU</th>
<th>Importer in EU</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>8,7999</td>
<td>3,0769</td>
<td>11,3791</td>
<td>11,3787</td>
<td>0,33</td>
<td>0,11</td>
<td>0,79</td>
<td>0,79</td>
<td>0,93</td>
<td>0,93</td>
<td>0,05</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>8,8469</td>
<td>3,1218</td>
<td>11,4203</td>
<td>11,4203</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Std. Dev.</strong></td>
<td>1,0362</td>
<td>0,2747</td>
<td>0,6711</td>
<td>0,6717</td>
<td>0,47</td>
<td>0,308</td>
<td>0,406</td>
<td>0,405</td>
<td>0,254</td>
<td>0,254</td>
<td>0,217</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>4,8192</td>
<td>1,7404</td>
<td>9,9488</td>
<td>9,9488</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>11,1482</td>
<td>3,5760</td>
<td>12,5568</td>
<td>12,5568</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Counts</strong></td>
<td>811</td>
<td>811</td>
<td>811</td>
<td>811</td>
<td>811</td>
<td>811</td>
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<td>811</td>
<td>811</td>
<td>811</td>
<td>811</td>
</tr>
</tbody>
</table>
5.4 Regression Results

5.4.1 Results First Regression

The results from the first regression, given for each and every year, are shown in table 5.4.1. The coefficients for each variable are given along with their significance and their \(t\)-values within brackets. As can be seen, the variables counting for distance, exporter’s GDP and importer’s GDP are all significant on the 1% level through the whole time period. The distance variable has a negative impact on trade meanwhile the sizes of the exporter’s and importer’s GDP have a positive impact; as expected from the gravity model.

The adjusted R-square value is high for all years; shifting from the values of 0.87 to 0.88; implying that the variances in the dependent variable \(\text{LnExp}\) are 87-88\% explained by this model, depending on year. The number of observations are changing from the three different sets, where it is lowest in the final regressions set (which can be explained by the fact that it has one year less).

The constant is negative and varies from -7.92 to -6.70 and is significant at the 1\% level for the three sets.

The coefficient for the dummy variable for common currency (\(\text{Cur}\)) is significant on the 1\% for all of the sets. It changes its impact to negative in the third set, implying (given the years 2007-2011) that introducing the euro to the country depressed the exports by 0.057\%.

The dummy variable for if the exporting country is part of the European Union (\(\text{EuExp}\)) is significant at the 1\% level in the first and third set. It begins having a positive trend from 1995-2000 and then becomes insignificant. In the third set it becomes significant at the 1\% level and has a positive impact on trade. Being part of the European Union in the third set increased the trade by 0.19\%.

The coefficient indicating if the importing country is part of the European Union (\(\text{EuImp}\)) is only significant at the 1\% level in the third set, where it increased trade by 0.16\%. In the first and second set it was insignificant. During the third set, being a member in the European Union increased trade by 0.16\%.

The values obtained through the three sets for distance are significant at the 1\% level and remains rather stable around -1.40. This implies that one percentage increase in distance decreased trade by 1.4\%.

The coefficient for the exporting country’s GDP (\(\text{LnY}_i\)) remains increases through the three sets, implying that a growing GDP promotes trade. The average value is lower than unity and at a value of 0.98, one unit added to GDP of the exporter increased the exports by 0.98\%.

The coefficient for the importing country’s GDP (\(\text{LnY}_j\)) has a minimum value of 0.7891 and a maximum value of 0.8022. The value of this variable in the third set equals 0.8022 and given this value, one unit added in GDP for the importer would result in a 0.8022\% increase in imports. The GDP for the importer follows the same pattern as GDP for the exporter – a growing GDP promotes trade between countries.
### Table 5.4.1. Regression One Results.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-6.7013***</td>
<td>-7.1262***</td>
<td>-7.9205***</td>
</tr>
<tr>
<td></td>
<td>(-28.7554)</td>
<td>(-35.7052)</td>
<td>(-36.5674)</td>
</tr>
<tr>
<td>LnDistance</td>
<td>-1.4125***</td>
<td>-1.3939***</td>
<td>-1.4051***</td>
</tr>
<tr>
<td></td>
<td>(-44.7862)</td>
<td>(-47.0343)</td>
<td>(-43.3541)</td>
</tr>
<tr>
<td>LnGDP Exporter</td>
<td>0.9389***</td>
<td>0.9807***</td>
<td>1.0037***</td>
</tr>
<tr>
<td></td>
<td>(78.0478)</td>
<td>(91.0205)</td>
<td>(95.2476)</td>
</tr>
<tr>
<td>LnGDP Importer</td>
<td>0.7891***</td>
<td>0.7897***</td>
<td>0.8022***</td>
</tr>
<tr>
<td></td>
<td>(62.4423)</td>
<td>(81.2404)</td>
<td>(85.6040)</td>
</tr>
<tr>
<td>Currency</td>
<td>0.1227***</td>
<td>0.0887***</td>
<td>-0.0568***</td>
</tr>
<tr>
<td></td>
<td>(5.4909)</td>
<td>(5.8326)</td>
<td>(-3.9579)</td>
</tr>
<tr>
<td>Border</td>
<td>0.1455***</td>
<td>0.1580***</td>
<td>0.1630***</td>
</tr>
<tr>
<td></td>
<td>(5.7456)</td>
<td>(6.7318)</td>
<td>(6.2148)</td>
</tr>
<tr>
<td>Landlocked</td>
<td>0.0286</td>
<td>-0.0249</td>
<td>-0.0404***</td>
</tr>
<tr>
<td>Exporter</td>
<td>(1.9059)</td>
<td>(-1.9494)</td>
<td>(-2.8605)</td>
</tr>
<tr>
<td>Landlocked</td>
<td>0.2406***</td>
<td>0.26***</td>
<td>0.2442***</td>
</tr>
<tr>
<td>Importer</td>
<td>(13.6912)</td>
<td>(15.2923)</td>
<td>(14.8298)</td>
</tr>
<tr>
<td>Exporter in EU</td>
<td>0.1160***</td>
<td>-0.0185</td>
<td>0.1856***</td>
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<tr>
<td></td>
<td>(6.8791)</td>
<td>(-1.2123)</td>
<td>(8.2430)</td>
</tr>
<tr>
<td>Importer in EU</td>
<td>0.0123</td>
<td>-0.0292</td>
<td>0.1568***</td>
</tr>
<tr>
<td></td>
<td>(0.6195)</td>
<td>(-1.9029)</td>
<td>(7.2982)</td>
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<td>0.0843*</td>
<td>-0.0331</td>
<td>-0.0031</td>
</tr>
<tr>
<td></td>
<td>(2.3859)</td>
<td>(-1.1268)</td>
<td>(-0.0941)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.8807</td>
<td>0.8764</td>
<td>0.8822</td>
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<tr>
<td>No. of obs.</td>
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<td>4868</td>
<td>4058</td>
</tr>
</tbody>
</table>

Note: T-stat given in brackets, * = significant at the 10% level, ** = Significant at the 5% level and *** = Significant at the 1% level

The dummy variable indicating borders ($Bor$) remains to have a positive impact and is significant at the 1% level throughout the three sets. Hence sharing a common border tends to increase the trade flow by 0.15-0.16 units and has had an impact on trade throughout the years.

The dummy variable for if the exporting country has coastal access ($LockExp$) is only significant at the 1% level in the last set with a negative sign. Implying that having access to a coast, as an exporting country, tend to decrease trade by 0.04%.

The coefficient for the dummy variable if an importing country has access to water ($LockImp$) remains significant at the 1% level in all of the years. This indicates that, as an importing country, access to coast tend to increase the trade flow (imports) by 0.24-0.26%.

The final dummy variable, where the coefficient of common language between two countries is measured, is only significant at the 5% level in the first regression set where it has a small positive effect on trade. In this case, sharing a common language increased trade by 0.08%.
5.4.2 Result Second Regression

The results from the second regression is given in table 5.4.2. As done in the previous table, the coefficients for each variable are given along with their significance and their t-values within brackets.

As can be seen in the table, the coefficients regarding the exporting and importing countries in terms of GDP as well as the distance are significant at the 1% level. This is what is expected as Linnemann (1966) and Tinbergen (1962) predicted. The constant is negative with a value of -7.02 and is significant at the 1% level.

The adjusted R squared in this model is high, 0.88, implying that the variances in the dependent variable (LnExp) are 88% explained by the model. The number of observations are of a total 13273.

The explanatory variable for distance implies that 1 percent increase of distance decreases the trade flow with 1.40 units. The explanatory variables for the exporting and importing countries are positive and 1 percentage increase in GDP would imply 0.97 units higher trade flow in terms of export and 0.79 units higher trade flow in terms of imports.

The coefficient for the dummy variable indicating common currency is significant at the 10% level and implies that having the same currency would increase the trade flows with 0.02%.

The coefficient for whether the exporting country is a member in the European Union is significant at the 1% level and a membership in the Union would tend to increase the trade flows by 0.03%.

The dummy variable is the variable for the European sovereign debt crisis. This variable is significant at the 1% level and the effect of the crisis tend to depress the trade flows by 0.13 units.

The dummy variables indicating if the importing country is landlocked, where value 1 was given if the country had coastal access, is significant at the 1% level and having access to the coast would increase the trade flows by 0.26%.

The dummy variable indicating common border is significant at the 1% level and sharing a common border would increase the trade flows by 0.16%.

The dummy variables for whether the exporting country is landlocked or not, if the importing country is a member of the European Union and the dummy variable for common language proved insignificant.

The yearly intercepts, generated from the dummy variable for each and every year, are positive and significant from 1996-2004 and year 2006 at the 1% level. The years 2005, 2007 and 2009 it is significant at the 5% level whereas it is positive years 2005 and 2007 and negative year 2009. Finally, it is significant at the 10% level year 2010. These intercepts shows that there are (where they are significant) yearly effects.
<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
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<tr>
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</tr>
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<td>-1.4049***</td>
<td>(-78.1342)</td>
</tr>
<tr>
<td>LnGDP Exporter</td>
<td>0.9722***</td>
<td>(156.7012)</td>
</tr>
<tr>
<td>LnGDP Importer</td>
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<td>(137.6478)</td>
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<tr>
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<td>(0.1877)</td>
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<tr>
<td>Landlocked Importer</td>
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<td>(26.3579)</td>
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<td>Year1997</td>
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</tr>
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<td>Year1998</td>
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<td>(14.1277)</td>
</tr>
<tr>
<td>Year2002</td>
<td>0.1962***</td>
<td>(12.0215)</td>
</tr>
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<td>Year2003</td>
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<td>Year2005</td>
<td>0.0426**</td>
<td>(2.7260)</td>
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<td>Year2006</td>
<td>0.1065***</td>
<td>(5.7358)</td>
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<td>Year2007</td>
<td>0.0458**</td>
<td>(2.5388)</td>
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<td>Year2008</td>
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</tr>
<tr>
<td>Year2009</td>
<td>-0.05**</td>
<td>(-2.7233)</td>
</tr>
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<td>Year2010</td>
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<td>(-1.9842)</td>
</tr>
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<td>Year2011</td>
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<td>(0.3243)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.8809</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.4.2. Regression Two results.

Note: T-stat given in brackets, * = significant at the 10% level, ** = Significant at the 5% level and *** = Significant at the 1% level
6. Analysis

The purpose with this paper was to test whether being a member of the European Union as well as adapting the currency of euro had any positive effect on bilateral trade between the European countries. The theory behind the gravity model is that the main actors of the trade flows are determined by the size of the country (in terms of GDP) and the distance between them.

The obtained adjusted R-square from both regressions show that the model of choosing is good at explaining, 87-88% of the variance in the exports in Europe.

The results, contained in figure 6.1, show that being a member of the European Union has a positive impact on exports throughout the years, except for as an importer in the first set of years 1995-2000 and for both exporters and importers years 2001-2006. However, the effect is larger between years 2007-2011 meanwhile it had a smaller impact between years 1995-2000. On the other hand, the effect of a membership in the European Union had a positive impact on the imports only during the years 2006-2011. Firstly after 2006 the significance increases to exceed an increase over 0.1%.

![Figure 6.1. Trend of Coefficient for European Union; Exporter and Importer. Where the red cross indicates that the coefficients generated are not significant at the 1% level.](image)

By adding the results from the dummy variable of Common Language (Lan), see figure 6.2, and its insignificance indicates that the introduction of the euro increased the willingness of trading with countries having the same currency rather than trading with countries with common language or being in the same Union. This can be explained by “the monetary efficiency gain from joining the fixed exchange rate system equals the joiner’s saving from avoiding the uncertainty, confusion, and calculation and transaction costs that arise when exchange rates float” Krugman and Obstfeld (2009). Thus the euro reduced the bilateral trade flow resistance in the first two sets in the first regression and helped to promote trade. Moreover, adding the dummy variable of border to this section, it can be observed that the impact of common border increased steadily throughout the three sets. This goes along with the impact of the common currency year 1999 as most of the countries, see appendix 1, who adopted the euro are bordered with each other.
Comparing the figures 6.1, 6.2 and 6.3 some correlations can be observed. It would seem that the effect of entering the European Union, in terms of bilateral trade, did not affect the willingness to trade with countries located further away. This can also be verified by the fact that the effect of being a part of the European Union declines the coefficient of distance remains the same as well. It is only after the beginning of the sovereign-debt crisis, with an impact of negative 0.13 units on trade (found in regression 2), the coefficient of European Union membership tends to positively change. This implies that as a structural change (Eucrisis) occurs countries prefer to trade with Union members, and by observing the effect of the dummy variable for borders in figure 6.2, that are closely located to each other.

The impact of common currency indicated that by the introduction of the euro the trade flows would increase by 0.12 units and then slowly decreased until it lost its significance from the results of the first regression, third set. It then changed to inducing a negative impact on trade flows where sharing a common currency would tend to decrease the trade flows by 0.06 units. As can be seen in figure 6.2 a negative trend can be seen for the variable of common currency. The first negative trend could be explained by the effects of the Asian financial crisis 1997, which struck East Europe 1998-1999 and later to be hit by the dot com burst by the millennia 2000. It would seem that the confidence for the euro declined and/or that the importance of sharing the common currency declined. The second regression, where the data was pooled, overall shows a 0.02 unit increase in trade flows, significant on the 10% level, if a common currency was shared. Hence the overall impact of the euro has proven to be positive in terms of trade.

Being a member in the European Union does indeed tend to increase the trade; promoting intra-EU trade instead of extra-EU trade. This can be stated from the information gathered in chapter 2, where the overall trade has remained mainly unchanged and at the same time intra-EU trade has increased. However, it has also been proven to be insignificant to be a part of the European Union during 1995-2006 in terms of an importer and during 2001-2006 as an exporter. The effect of a shared border has proven to be significant and stable throughout the study – indicating that increase in trade flows are more likely to be higher between countries sharing the same border. On the other hand, the effect of a shared currency indicates that, since the year 2007, trade flows are negatively affected. Trade at this point is more observed in countries not sharing the same currency but instead with countries in the same union as figure 6.1 shows.

Figure 6.2. Trend of Coefficient for Common Border, Language and Currency. Where the red cross indicates that the coefficients generated are not significant at the 1% level.
The GDP trend for the importing and exporting country in the time period, figure 6.3, proved significant at the 1% level all years and are, together with the distance, the most important variables in this model. The small rise in the GDP of both exporting country and importing country can be explained by the two additional countries in the sample as well as more observations. The GDP of the exporting country remains stable around unity, implying that 1% increase in GDP of the exporting country tend to increase the exports with 1 unit. The coefficient for GDP both as an exporter and an importer are increasing; implying that trade grows faster than the growth of the GDP. The GDP of the importing country is always less than unity (as observed by Tinbergen, 1962) and has, since the start, a generally smooth trend with small fluctuations.

The distance, figure 6.3, between each country proved to be significant at the 1% level in all years and has a negative impact on trade. The introducing of the euro 1999 slightly changed the coefficient of distance, implying that it has less of an impact on trade. It remains stable around the negative value of 1.4 and fluctuates in small values through the years. Generally the impact of distance was expected to decrease through the years, however this (mostly) unchanging value can be explained due to the countries in the sample along with its historical aspect. Its impact was expected to decrease as an increase in the technology level, types of transport and a decrease in costs of transports would most likely tend to increase the willingness to trade – even with countries located further away. However, this can be explained by Europe and its countries being generally more efficient in constructing networks of trade between themselves. Additionally, as the European countries have become integrated new technological improvements are easier and faster adopted by the countries and would therefore decrease their transportation cost proportionally and thus do not have an impact on the coefficient (Buch, Kleinert and Toubal, 2003).

The effect of coastal access, appendix 7, as an importer proved to be significant at the 1% level in all of the years and both regressions. The observable trend can be found in the appendices. This result was expected as mentioned in the assumptions, the coastal access tend to decrease
transportation costs and thus increase the trade flows, Brakman, Garretsen and van Marrewijk (2009). However, more interesting is the coefficient trend for whether the exporting country has coastal access. It proved to be significant only once, during the third set in the first regression, at the 1% level and had a negative coefficient of 0.04. This result was not expected from theory and could imply that even if a country is having coastal access, the country benefit more from having a central part in Europe. This would in turn decrease distance between the countries and it would seem that the cost of distance exceeds the cost of being landlocked.

The distance factor has generally slightly decreased from 1995 to 2011 and adding the insignificant common language coefficient variable shows that geographical importance is declining. On the other hand, the common border variable still indicates that geographical location has a strong, positive and significant effect on trade.

![Trend of Year Dummies](image.png)

Figure 6.4. Trend of Coefficient for Year Dummies from Regression 2. Where the red cross indicates that the coefficients generated are not significant at the 1% level.

The yearly intercepts generated from the second regression are shown in figure 6.4 and represents the mean bilateral trade, in terms of export, conducted in each and every relevant year. The differential intercepts shows how much the average value of exports in each relevant year differs from the benchmark year 1995 (Gujurati and Porter, 2009). Hence if the relevant year is 2001, with a value of 0.2327, tells us that trade increased by 0.2327 units. As can be seen the coefficient values has a positive, although fluctuating, trend until year 2001 where it then decreases and falls into insignificance year 2004, 2006 and forward. This trend can be explained by the upcoming financial crisis in Europe which inflicted a structural break with the start of 2007. These results are also inconsistent with figure 6.1, the coefficient for a membership in the European Union and the theory in chapter 2 where, with the start of the financial crisis, trade has not generally increased as, on the other hand, intra-EU trade has.
7. Conclusion

The main purpose of this paper was to investigate the impact of membership in the European Union and adopting the currency of euro had on bilateral trade. Given a pair of countries and the size of their GDP, the distance between them had the largest impact on the bilateral trade flows. However, being a member of the European Union tend to increase the intra-EU trade, due to preferential trading agreements, but at the cost of extra-EU trade. This can be seen through chapter 2 as trade has not increased generally in the European Union. Thus, with an increase in intra-EU trade this must come at the cost of extra-EU trade.

The findings goes along with the previous work done by Philippa Dee and Jyothi Gali (2005) where their conclusions were that the preferential trading agreement in Europe failed to have an impact on trade. The only boost in trade that can be observed is the expense on non-members. However, the main purpose of a membership in the European Union might lie within the reasons mentioned in the first chapter. Namely “to enhance Europe’s role in the world monetary system and to turn the European Union into a truly unified market” Krugman and Obstfeld (2009).

The case with sharing a common currency proved to have a positive impact on trade to later become negatively significant, at the 1% significance, implying to have a negative impact on trade. The conclusion is that the findings by Baldwin, Skudelny and Taglioni (2005) where the “Rose-effect”, the effect of a currency union on trade, can be verified in the findings up until 2003 (disregarding 2002 of insignificance). However, the variable then lost importance making it hard to determine its continuous trend. Baldwin (2006) stated in his study that the euro did indeed boost the intra-EU trade by 5-10% up until 2005 which is a statement that should not rejected, however the future impact of the euro is still to be investigated.

The results found in the regression shows that since the crisis the euro has had a negative significant impact on trade. This in turn implies that a solution to the problem might lie within the devaluation of the euro which would tend to increase exports and thus, in the long-run, help the indebted countries to return to their normal economic welfare. However, devaluation would also lead to inflation of the euro as there are countries close to full employment. And as mentioned in the introduction; inflation is not, to say, Germany’s cup of tea.

The impact of the financial crisis, which showed to be significant at the 1% level and reducing trade by 0.13 units from the second regression, has further also “demonstrated the vulnerability of the euro-area countries to cross-border financial spillovers”, European Commission (2011). The benefit from the crisis is the exposure of the failures and lack of coordination between the members in the European Union. This might in turn lead to a closer integration and coordination in a macroeconomic approach, labor and credit markets as well as product and services market in the future.

As the financial crisis affected the countries in Europe differently the result has developed a broader divergence in the Union. Divergence between countries in a monetary union are, to a certain degree, not bad as these can increase foreign direct investment into the less developed countries. However, when these divergences become too big problems with corporate debt and unsustainable accumulation of households, problems such as misplaced investments may cause future problems “… Capital inflows in many of the deficit countries fuelled the asset price bubbles rather than productive investment” Felke (2011). Divergence in growth rates in the countries may also lead to different intra-area real effective exchange rates which is showed in appendix 8; reported by the European Commission. Meanwhile the surplus countries, such as Germany and Finland, experience an undervalued currency the deficit
countries faces an overvalued currency. Germany, with an ‘undervalued currency’ experience a growing GDP as the firms can exploit the situation by selling their goods cheaper than normal. On the other hand, the deficit countries such as Greece and Spain experience a cheap import – building up a trade deficit which was followed by borrowing of money.

It would appear that this work has created more questions than answered; which in turn could be the case for future studies. There are many big and necessary subjects to address in the close future. Were the divergences too big already with the introduction of the euro or where they created from growth difference? What may be a solution to the problem? Should the currency Union split in two, are the rewards of excluding one country greater than the costs or does these extraordinary times require extraordinary measures? When the matter of splitting the Union/from the Union is actual then in what extension would the sunk cost of invested capital, a new currency and so on be? Perhaps the more reasonable way to approach the problem lies within devaluation of the euro.
References

Theory References

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Figure References

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Appendix

Appendix 1

Country and Year of Adopting the Euro

1999 Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland

2001 Greece

2002 Introduction of euro banknotes and coins

2007 Slovenia

2008 Cyprus, Malta

2009 Slovakia

2011 Estonia

Appendix 2

The Member States of EU and the 2 Additional Countries Added in the Sample.

<table>
<thead>
<tr>
<th>Member states of the EU (EU-27)</th>
<th>Year of entry</th>
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</thead>
<tbody>
<tr>
<td>Austria</td>
<td>1995</td>
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<tr>
<td>Belgium</td>
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</tr>
<tr>
<td>Bulgaria</td>
<td>2007</td>
</tr>
<tr>
<td>Cyprus</td>
<td>2004</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>2004</td>
</tr>
<tr>
<td>Denmark</td>
<td>1973</td>
</tr>
<tr>
<td>Estonia</td>
<td>2004</td>
</tr>
<tr>
<td>Finland</td>
<td>1995</td>
</tr>
<tr>
<td>France</td>
<td>1952</td>
</tr>
<tr>
<td>France</td>
<td>1952</td>
</tr>
<tr>
<td>Germany</td>
<td>1952</td>
</tr>
<tr>
<td>Greece</td>
<td>1981</td>
</tr>
<tr>
<td>Hungary</td>
<td>2004</td>
</tr>
<tr>
<td>Ireland</td>
<td>1973</td>
</tr>
<tr>
<td>Italy</td>
<td>1952</td>
</tr>
<tr>
<td>Latvia</td>
<td>2004</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1952</td>
</tr>
<tr>
<td>Malta</td>
<td>2004</td>
</tr>
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<td>Netherlands</td>
<td>1952</td>
</tr>
<tr>
<td>Poland</td>
<td>2004</td>
</tr>
<tr>
<td>Portugal</td>
<td>1986</td>
</tr>
<tr>
<td>Romania</td>
<td>2007</td>
</tr>
<tr>
<td>Slovakia</td>
<td>2004</td>
</tr>
<tr>
<td>Slovenia</td>
<td>2004</td>
</tr>
</tbody>
</table>
Spain 1986
Sweden 1995
United Kingdom 1973
Norway -
Switzerland -

Appendix 3
Germany’s Historical Inflation. Where percent of inflation on y-axis and year on x-axis.

![Graph showing historical inflation trends for Germany](image)

Appendix 4
Correlation Matrix.

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Inexp</th>
<th>Inexp</th>
<th>Inexp</th>
<th>Inpimp</th>
<th>Border</th>
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<th>Currency</th>
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<th>LockImp</th>
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<th>EUImp</th>
<th>Eucrisis</th>
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<td>0.044</td>
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<td>0.298</td>
</tr>
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<td>0.833</td>
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<td>-0.033</td>
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<td>-0.032</td>
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<td>-0.005</td>
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<td>0.081</td>
<td>0.244</td>
<td>0.487</td>
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<td>-0.006</td>
<td>-0.005</td>
<td>0.238</td>
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Appendix 5

Cities Used for Measuring the Distance.

Austria – Wien
Belgium – Brussels
Bulgaria – Sofia
Cyprus - Nicosia
Czech Republic – Prague
Denmark – Copenhagen
Estonia - Tallinn
Finland - Helsinki
France – Paris
Germany - Berlin
Greece - Athens
Hungary – Budapest
Ireland - Dublin
Italy - Rome
Latvia – Riga
Lithuania – Vilnius
Luxembourg – Luxembourg
Malta – Valletta
Netherlands – Amsterdam
Poland – Warsaw
Portugal - Lisbon
Romania – Bucharest
Slovakia - Bratislava
Slovenia - Ljubljana
Spain - Madrid
Sweden – Stockholm
United Kingdom – London
Switzerland - Bern
Norway – Oslo
Appendix 6

Heteroscedasticity. The residuals plotted against the predicted values and where suspicions arose regarding heteroscedasticity. From upper left to right, regression 1.1, 1.2, 1.3 and lower right regression 2.

Appendix 7

The Effect of Coastal Access in Terms of an Exporter and Importer. Where the red cross indicates that the coefficients generated are not significant at the 1% level.
Appendix 8

Intra-area Real Effective Exchange Rate Developments, Based on GDP Deflator, Euro-area Member States (1998-2010, 1998=100).